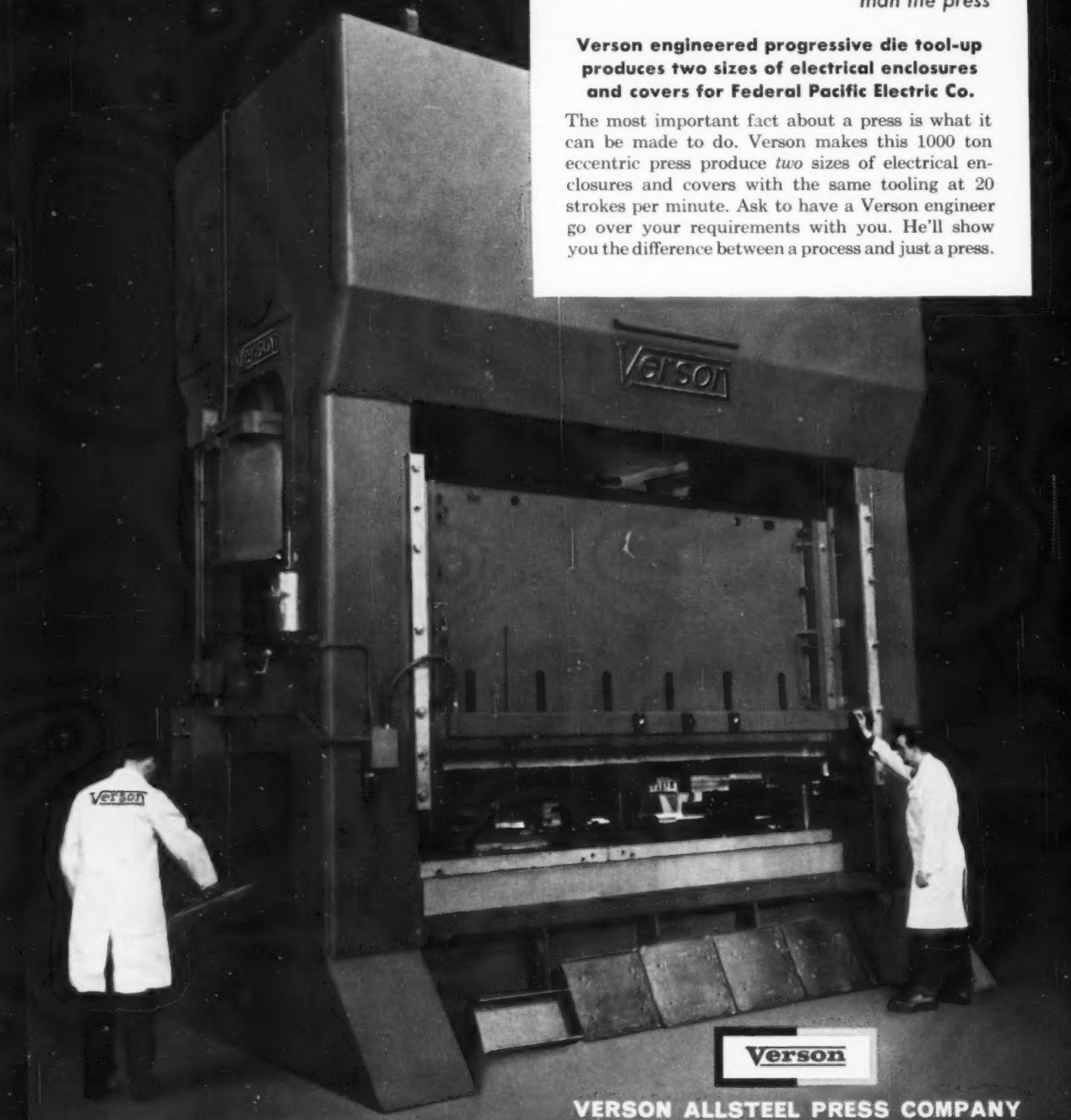
AUGUST 1959 — SIXTY-FIFTH YEAR

Machinery

The process is more important than the press

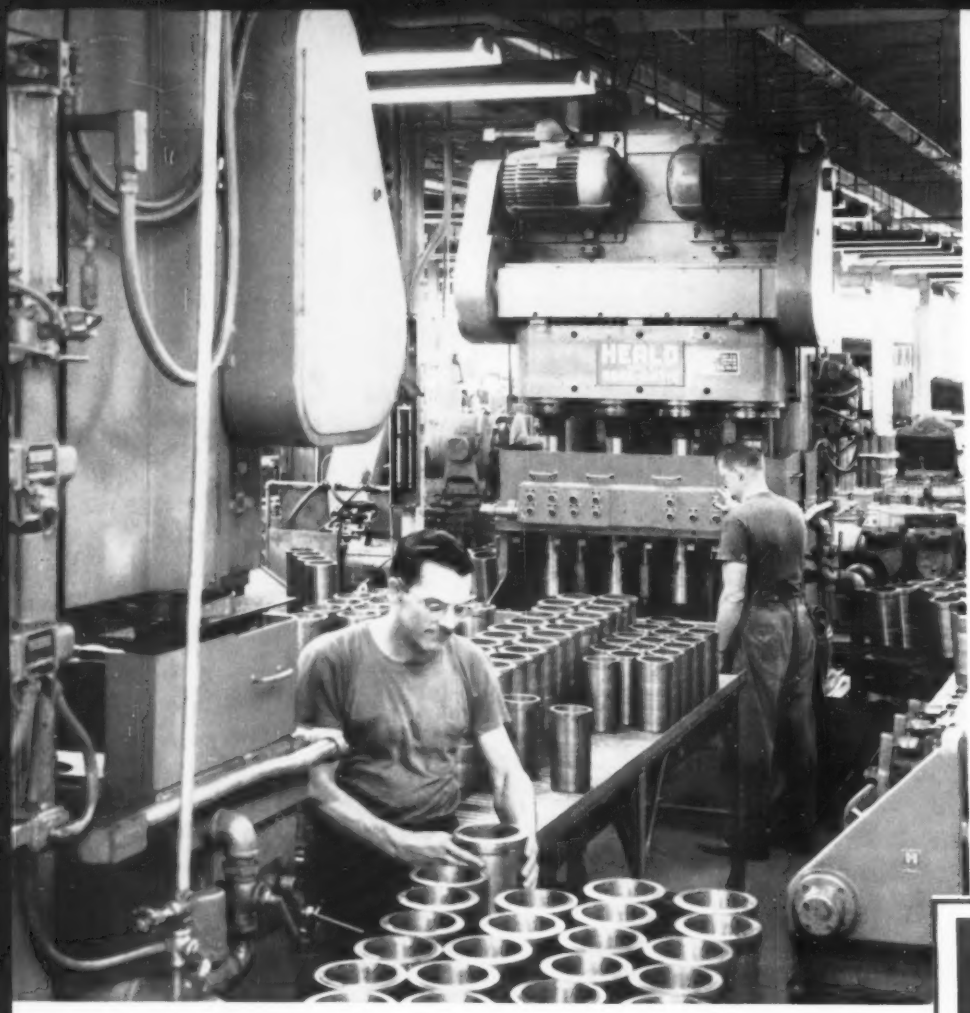
Verson engineered progressive die tool-up produces two sizes of electrical enclosures and covers for Federal Pacific Electric Co.

The most important fact about a press is what it can be made to do. Verson makes this 1000 ton eccentric press produce *two* sizes of electrical enclosures and covers with the same tooling at 20 strokes per minute. Ask to have a Verson engineer go over your requirements with you. He'll show you the difference between a process and just a press.



Verson

VERSON ALLSTEEL PRESS COMPANY
CHICAGO • DALLAS



Two Heald Model S Bore-Matics installed in diesel engine plant for rough and finish boring cast iron cylinder liners. Unit in foreground performs the roughing operation, with capacity of up to ¼" of stock removal on four parts at a time, followed by finish boring on identical machine at the right.

HEALD

KING-SIZE BORE-MATICS

rough and finish bore diesel cylinder liners FOUR AT A TIME

HEAVY-DUTY roughing and precision finish boring are the dual functions of the two Heald Model S Bore-Matics shown above. Installed in a large diesel engine plant, these huge, 40,000-pound machines are identical except for tooling — each handling four large cast iron cylinder liners at a time.

One machine, used for the roughing operation, is capable of removing a full quarter inch of stock — the other is used for finish boring to close tolerances for size and concentricity. Each four-station machine is equipped with a hydraulic clamping fixture and operates on a fully automatic push-button-controlled cycle. Total cycle time is 266 seconds on the roughing operation, with a net production of approximately 40 parts per hour.

These big vertical Bore-Matics are further evidence of Heald's ability to handle all phases of a machining operation from rough casting to finished part on any size work.

It PAYS to come to Heald

THE HEALD MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.

Worcester 6, Massachusetts

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AUGUST 1959

VOL. 65 No. 12

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BPA NBP

Machinery

THE MONTHLY MAGAZINE OF ENGINEERING AND PRODUCTION IN THE MANUFACTURE OF METAL PRODUCTS

SHOP PRACTICE

Spinning, Swaging, and Flaring Tubular Parts ..... Charles O. Herb 89
Missile Guidance System Tooled for Production ... D. G. Gill and C. D. Spainhour 94
Jet-Age Drilling at Convair ..... Thomas W. Driver 104
Plastic-Faced Press Tools ..... Raymond H. Spiotta 108
Iron Ore to Strip Steel at Republic's Research Center 128
Advanced Machine Tools for Large Turbine-Generators 142
Machine-Trio Cuts Short-Run Piercing Cost 146

MACHINE AND TOOL DESIGN

Gears for Outer Space ..... M. A. Hartman 115
Threading on a Tool and Cutter Grinder ..... H. J. Gerber 122
One Drill Bushing Locates Two Holes ..... Cliff Bossmann 123
Convenient Work-Clamp for Vertical Boring Mill ..... A. G. Amos 124
Announcing MACHINERY'S New Ingenious Mechanism Competition .....
..... See Details on Page 125
Eccentric Gears Feature of Bag-Folding Device ..... Ralph T. Stewart 126
Intermittent Feed for Strip Material 127
American Standard Driving and Spindle Ends for Portable Air and Electric Tools (Data Sheet) 171

MANAGEMENT PROBLEMS

Postponement Costs Money ..... Charles O. Herb 87
Middle-Managers Needs Training, Too ..... Bernard Lester 147

REFERENCE SECTION

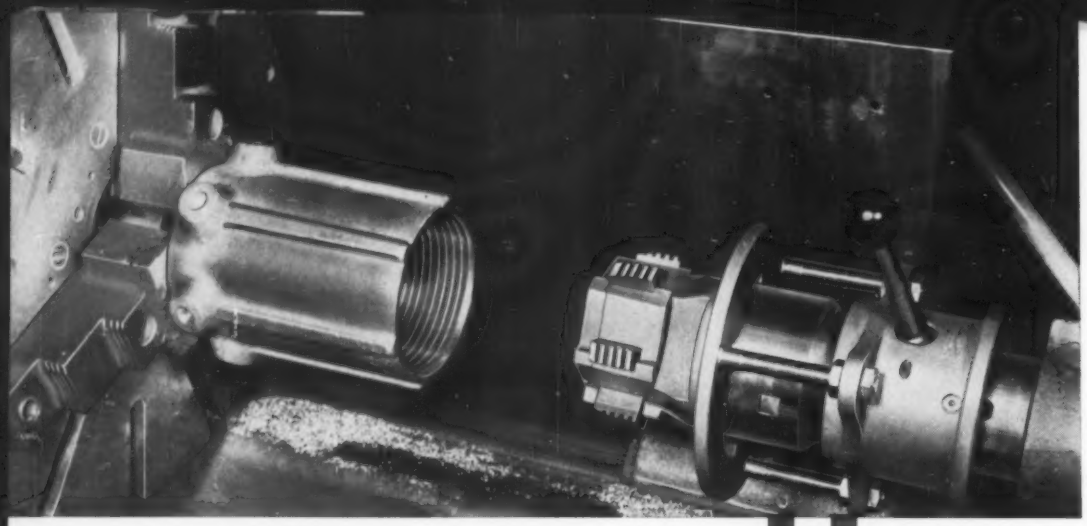
What the Designer Should Know about Production—Part 10
Die-Casting ..... A. L. McGroarty 129

DEPARTMENTS

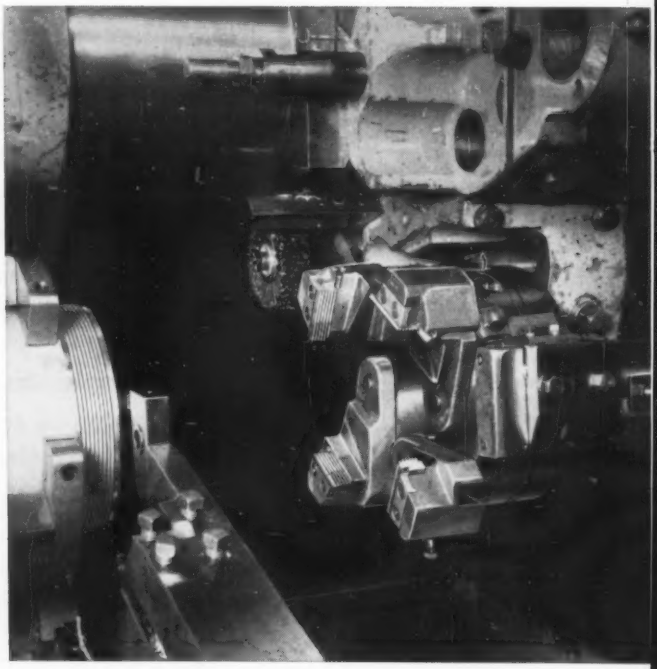
Keeping Up with Washington 85
Tool Engineering Ideas 122
Ingenious Mechanisms 126
Materials 139
Talking with Sales Managers 147
Latest Developments in Shop Equipment 148
Data Sheet 171
Between Grinds 192
News of the Industry 194
New Catalogues 199
Coming Events 210
Book Reviews 208

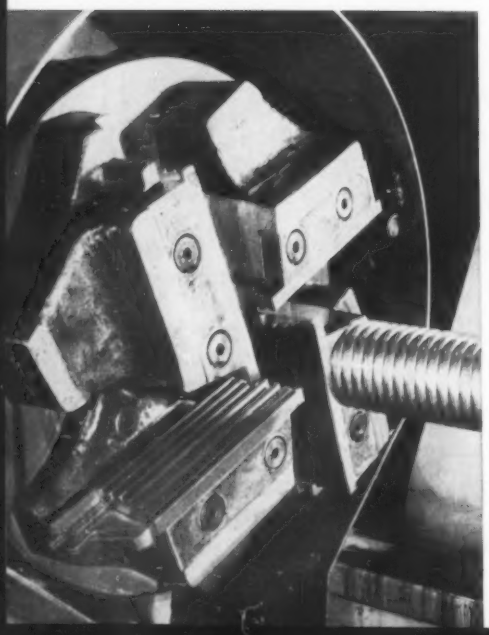
PRODUCT DIRECTORY
214

ADVERTISERS' INDEX
275-276



the world's largest selection of **thread**





THREADING EFFICIENCY . . .

requires the selection of the proper Thread Cutting Tool for the job to be done, and is the essence of LANDIS design. To ensure that you may use the most efficient threading tool, LANDIS manufactures the world's largest selection of Thread Cutting Tools . . . both internal and external.

cutting tools

DIE HEADS . . . in a range of ⅛"—9¼" for threading machines, turret lathes, screw machines, reversing spindle machines, bar automatics. *Heat-Treated* types for economy, wide range coverage, quick set-up changes and oversize capacity. *Hardened and Ground* types for work on which extreme accuracy and maximum production are of prime importance. *Solid Adjustable* types for high production threading on reversing spindle machines.

TAPS . . . in a range of 1¼"—24". *Collapsible Taps* for producing parallel threads, *Receding Chaser Collapsible Taps* for tapered threads. Both have wide diametrical range through use of detachable heads. *Non-Collapsing Solid Adjustable* types for high production tapping on reversible spindle machines. Special Taps are available.

CHASERS . . . all Landis Die Heads use Landis Tangential Chasers featuring: interchangeability, natural cutting clearance, permanent throat, useable for most of their length, right- and left-hand threads with the same chasers, and changeable rake and lead angles. Landis Tap Chasers, manufactured with the same consistency of quality and experience as the Tangential Chaser, are "tailor-made" to suit the application to produce a high degree of thread finish and the maximum number of pieces between grinds.

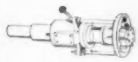
The constant research for better threading methods which has brought to LANDIS leadership in its field today plays an even more important part in our activities. We offer all manufacturers our over 50 years experience in all phases of Threading. If you need help involving threads, whether design or production, or if you feel that your present threading methods should be improved, send us your specifications, or our representative will call at your convenience on request.

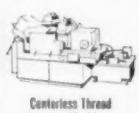
LANDIS *Machine* COMPANY WAYNESBORO PENNSYLVANIA

THE WORLD'S LARGEST MANUFACTURER OF THREADING EQUIPMENT

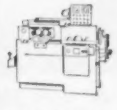
Threading Machines

Die Heads—Rotary & Stationary


Taps—Collapsible & Solid Adjustable


Centerless Thread Grinding Machines

Thread Rolling Tools


Thread Rolling Machines

553C

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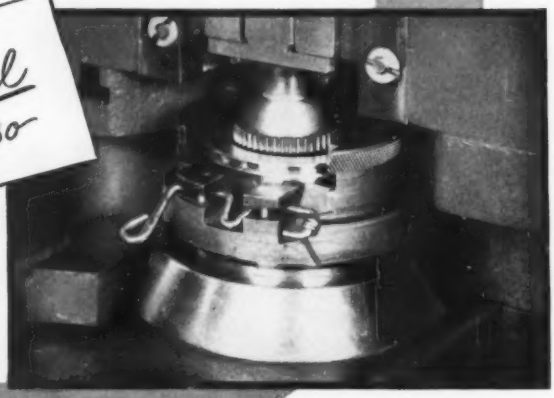
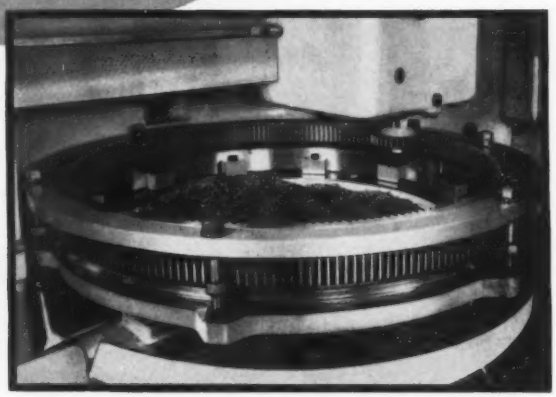
FELLOWS GEAR SHAPERS cut INTERNAL Gears

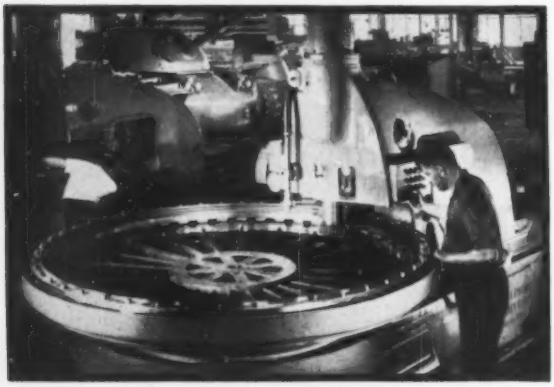


5" Fine-Pitch Gear Shaper cutting internal gear.

No. 10 Rotary Gear Shaper cutting internal helical.



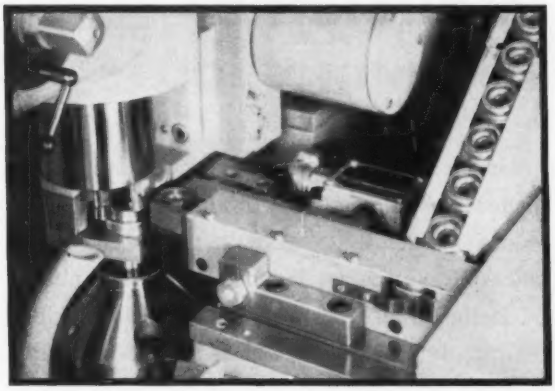
36-Type Gear Shaper with special work-holding fixture.



120" Gear Shaper cutting light tank turret gear.

THE
PRECISION
LINE

as EASILY as Externals



4GS Gear Shaper with full-automatic operation.

7A-Type Gear Shaper with fast-action diaphragm chuck.

Not only internal gears, but splines, clutches and an almost unlimited variety of other internal shapes can be produced on versatile Fellows Gear Shapers just as simply, rapidly and economically as external shapes. In many cases, the same Gear Shaper cutter can be used to cut both internal gears and their mating pinions.

Set-ups and change-overs are simple and fast on any Gear Shaper from the 3-Inch Fine-Pitch to the 120-Inch. Rigid construction makes it possible to hold close tolerances at high production rates. On some models, full or semi-automatic operation is available whenever the size and shape of the work and the production requirements make it practical.

Your Fellows Representative can give you full information about the production benefits of Fellows gear shapers, shaving machines, grinding machines, inspection instruments, or cutting tools. Just contact the nearest Fellows office.

THE FELLOWS GEAR SHAPER COMPANY
78 River Street, Springfield, Vermont
Branch Offices: 1048 North Woodward Ave., Royal Oak, Mich.
150 West Pleasant Ave., Maywood, N. J.
5835 West North Avenue, Chicago 39
6214 West Manchester Ave., Los Angeles 45

Fellows *Gear Production Equipment*

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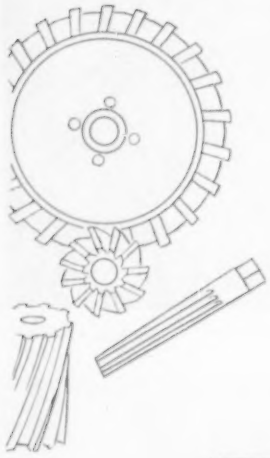
FOR TOP METAL CUTTING

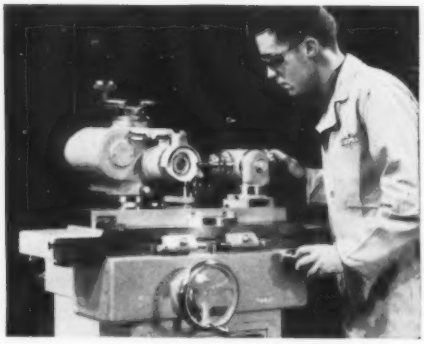
CINCINNATI GIVES YOU A CHOICE OF 5



To get the most out of your machine tools, you should operate them *all day, every day,* at a consistently high rate. And essential to this high efficiency is a strong secondary line of production, such as CINCINNATI Cutter and Tool Grinders. Here you have a choice of five machines designed to grind just about every cutter in your shop . . . including all types of milling and die sinking cutters, reamers, hobs and taps. CINCINNATIS do the job quickly and accurately, restore cutters to their most effective cutting trim.

For complete information concerning the maintenance of expendable tools, talk to our Cutter Grinder Specialists, or write for catalogs.

CONTOUR offers big savings for shops having a volume of form milling operations. It grinds form milling cutters (illustrated) on the periphery of the teeth to a definite cutting clearance chosen for the work material. Contour ground cutters produce a greatly superior finish at a higher feed rate. Catalog No. M-1918-1.



No. 1—Companion machine to the larger No. 2, perfect for shops using only small- to medium-sized cutters such as the small face mill being ground above. Timesaving features include anti-friction table slide; eccentric wheelhead swivel mounting; reversible motor built into wheelhead; three-way controls. Capacity: 8″ swing over table, 15″ between centers. Catalog No. M-1852-3.

BUILDERS OF FINE MACHINE TOOLS: KNEE TYPE AND BED TYPE MILLING MACHINES • DIE SINKING MACHINES •

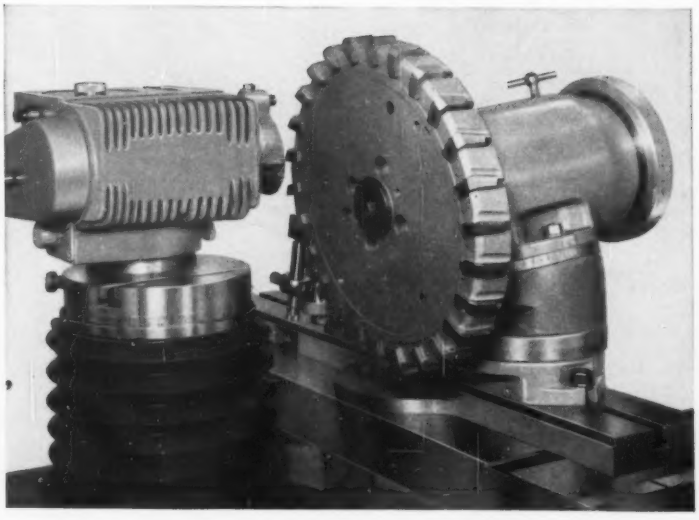
THE CINCINNATI MILLING MACHINE CO., CINCINNATI 9, OHIO

EFFICIENCY . . .

CUTTER AND TOOL GRINDERS

CINCINNATI

MONOSET sharpens, repairs and makes small cutters, including countersinks, those required for die sinking (illustrated), and other unusual shapes. Because of its universal construction, most jobs can be completed in one chucking. Built-in spiral lead mechanism generates infinitely variable helices, right- or left-hand, $1\frac{13}{16}$" min. lead. Catalog No. M-1591-4.



No. 2 with Face Mill Attachment here grinds a heavy 18" diameter face mill. The No. 2 is designed to handle the majority of cutters used in metalworking shops . . . milling cutters, reamers, hobs, taps, planer tools. Other attachments include Radius Grinding; Indexing for Workhead; Dust Exhaust; Spring Chucks and Collets. Capacity: 10" swing over table, 27" between centers. Catalog No. M-1914-4.

PROJECTO-FORM—For grinding small, accurate profile shapes on flat form cutters, lamination die parts and similar components. This machine combines grinding with an optical comparator unit. Work profile is enlarged 20 (or 40) times size on ground glass viewing screen directly in front of operator, as shown in the illustration above. Master drawings are made on Layout Scribing Machine. Catalog No. M-1612-5.

CUTTER AND TOOL GRINDERS • ELECTRICAL DISCHARGE MACHINES

CINCINNATI®
MILLING MACHINE DIVISION

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LANDIS
micro

feed

automatically cancels all variables affecting work size

MICROFEED is the most notable advance in precision grinding accuracy in years. New Landis grinders with MICROFEED will produce parts to extremely close tolerances regardless of machine temperature variations, wheel wear, wheel pressure changes and work variations.

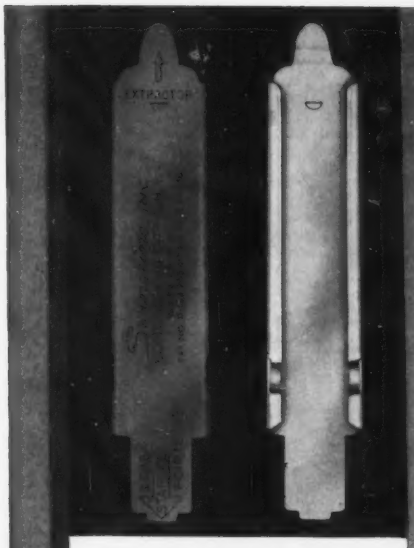
Precision to your tolerances on a production basis is assured, automatically.

LANDIS

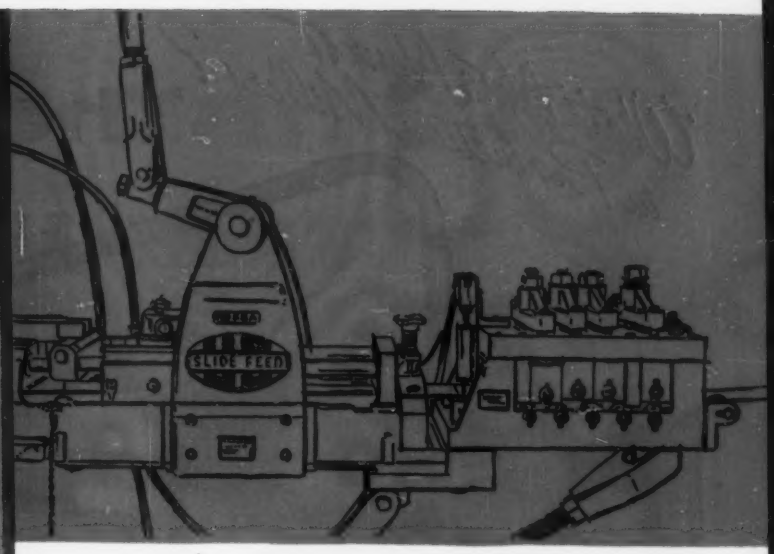
precision grinders

LANDIS TOOL COMPANY / WAYNESBORO, PENNSYLVANIA

Swingline 101
Staple Gun
The Tool of a
1000 Uses.
Swingline
FULL
EMPTY
101
Swingline INC.
MANUFACTURERS OF STAPLERS, STAPLES & OFFICE SPECIALTIES
TURNS TO
U.S. PRESS ROOM
EQUIPMENT
U S
MULTI-ROLL
CRADLE
SLIDE FEED



FRONT and BACK views of #101 Staple Gun base.



■ Swingline, Incorporated, represents another example of the reliance successful manufacturers place upon U. S. Press Room Equipment.

In the manufacture of their "Swingline No. 101 Staple Gun" Swingline utilizes the U. S. team of "Cradle to Straightener to Slide Feed" — a perfectly matched combination.

Swingline, in the production of their 101 Staple Gun, fabricates the 101 base from .062" coil stock, 1.468" wide. Stock is unwound from a model ACC-1-9C U. S. Multi-Roll Cradle. From the Cradle, stock leads into a model SS-27 U. S. Plain Stock Straightener which removes coil set. The stock is drawn through the Plain Straightener by a model SF-68A U. S. Slide Feed and accurately fed to the press with a feed stroke of 5⅜", at a rate up to 4000 per hour. This particular U. S. Slide Feed has a maximum stock width capacity of 6" and a maximum feed length adjustable up to 8".

As it has for Swingline and many other manufacturers, U. S. Press Room Equipment can help you to produce a fine product, economically. If yours is a press room production operation, get the complete story about U. S. Press Room Equipment by sending for Bulletin No. 85M.

MULTI-SLIDE

U. S. TOOL COMPANY, INC. AMPERE (East Orange) NEW JERSEY

U. S. Multi-Slides® • U. S. Multi-Millers® • U. S. Automatic Press Room Equipment • U. S. Die Sets and Accessories

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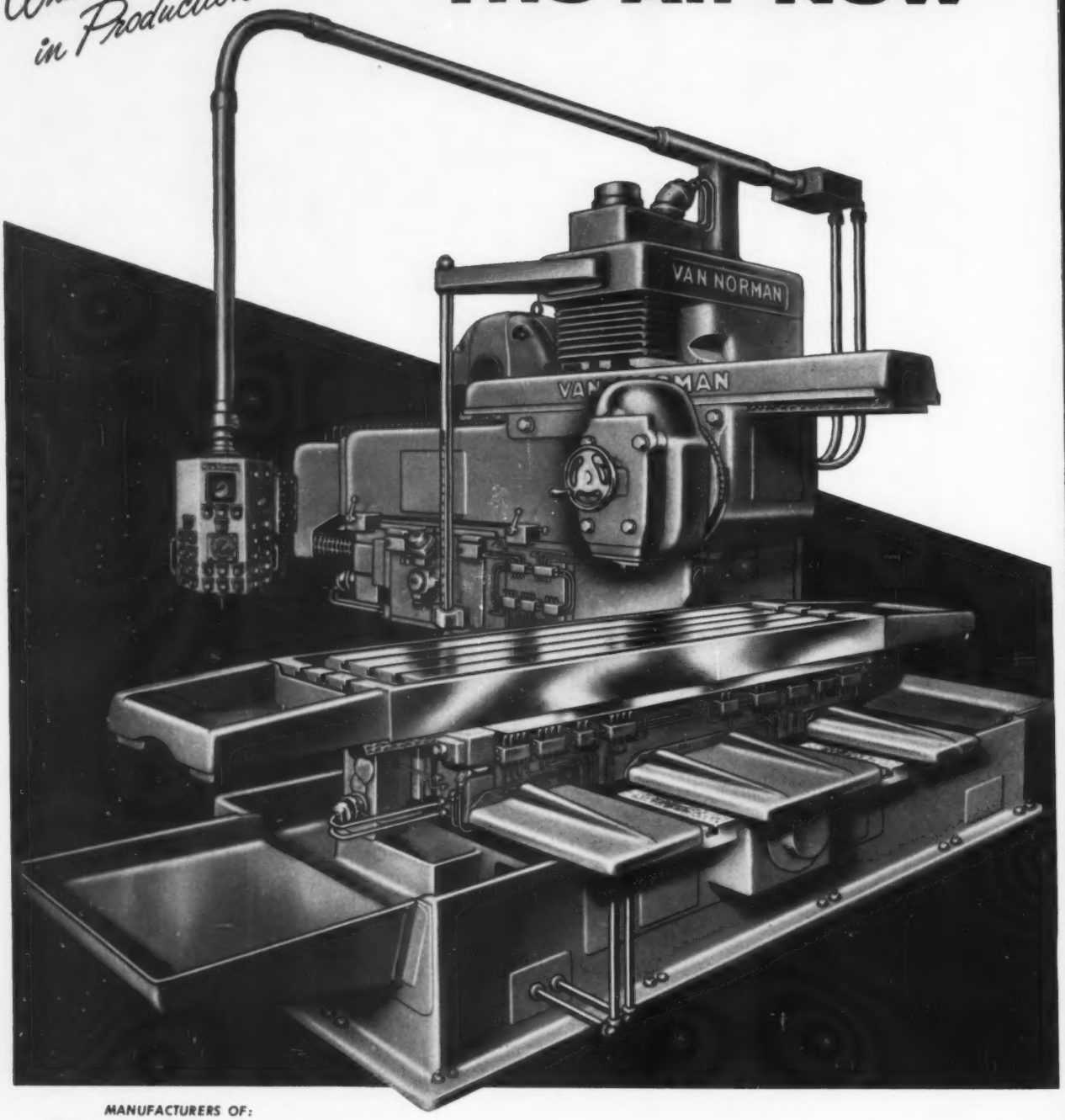
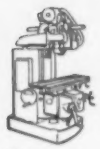
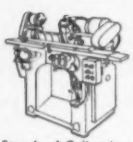
What's New Newest in Production Millers?

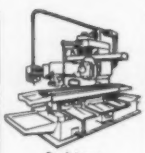
The All-New

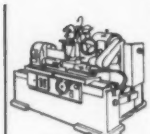


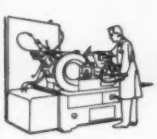
MANUFACTURERS OF:


Milling Machines


Standard Cylindrical Grinders


Bed-type Mills


Production Grinders


Centerless Grinders

VAN NORMAN

SPRINGFIELD 7, MASSACHUSETTS

Van Norman 746
VERSI-MATIC

- **Designed and built for modern production**
- **Engineered for numerical control**
- **Offers maximum rigidity — accuracy — versatility — range — horsepower**
- **An 18-ton precision-built bed-type miller**
- **Also available without saddle**

Here it is — the newest thing in production millers — just the machine to cut or shape all of the new, tough super alloys while still maintaining exacting tolerances. *And* the 746 retains all the famous Van Norman quality features including the exclusive Van Norman 4-way cutterhead.

Examine closely the detailed specs of this newest Van Norman production miller. Then contact your nearest Van Norman dealer or write directly to Springfield.

We'll be glad to show you how the 746 Versi-Matic can fit into *your* production line.

SPECIFICATIONS

NO. 746 VERSI-MATIC VAN NORMAN SADDLE BED TYPE MILLING MACHINE
NO. 796 VAN NORMAN BED TYPE MILLING MACHINES

		746 with Saddle	A.I.A.* Med. Size	796 without Saddle
TABLE SIZE	Length	96"	94"	108" also 130"
	Width	24"	20"	30"
	T-Slots (3)	1 3/16"	1 3/16"	1 3/16"
POWER FEED TRAVEL	Longitudinal	50"	50"	72" also 108"
	Transverse (Saddle)	14"	14"	—
	Transverse (Ram)	44"	—	44"
	Vertical	35"	20"	48"
CLEARANCE MAX.	Spindle to Table (Horiz.)	35"	20"	48"
	Spindle to Table (Vert.)	22"	—	35"
	Cutter Dia.	16"	16"	16"
POWER FEEDS IPM	Longitudinal (Table)	1/3-90	1/3-90	1/3-90
	Transverse (Saddle)	1/3-90	1/3-90	1/3-90
	Transverse (Ram)	1/16-45	—	1/16-45
	Vertical	1/16-45	1/16-45	1/16-45
	No. Steps	Inf.	32	Inf.
	Rapid Traverse (Table & Saddle)	150	150	150 (table only)
	Rapid Traverse (Vert. & Ram)	75	—	75
SPINDLE	Horsepower	25 50	25 50	25 50
	R.P.M.	15-1500	15-1500	15-1500
	No. Steps	18	16	18
	Head Swivels	120° (30° by vert.)	—	120° (30° by vert.)
	Taper	ASA 50	ASA 50	ASA 50
	Flange	ASA 60	ASA 60	ASA 60
WEIGHT	Net approximately	37,000 lbs.	—	41,000 lbs.

*Aircraft Industries Association NAS-909 Specifications.

MACHINE COMPANY
A DIVISION OF VAN NORMAN INDUSTRIES, INCORPORATED

Don't wait . . . for extra profit install a Van Norman machine now! They are available in many purchase plans . . . Outright sale . . . Purchase on conditional sales contract up to five years . . . Pay as you depreciate up to 10 years. Conditional Sales Contracts not available to Export.

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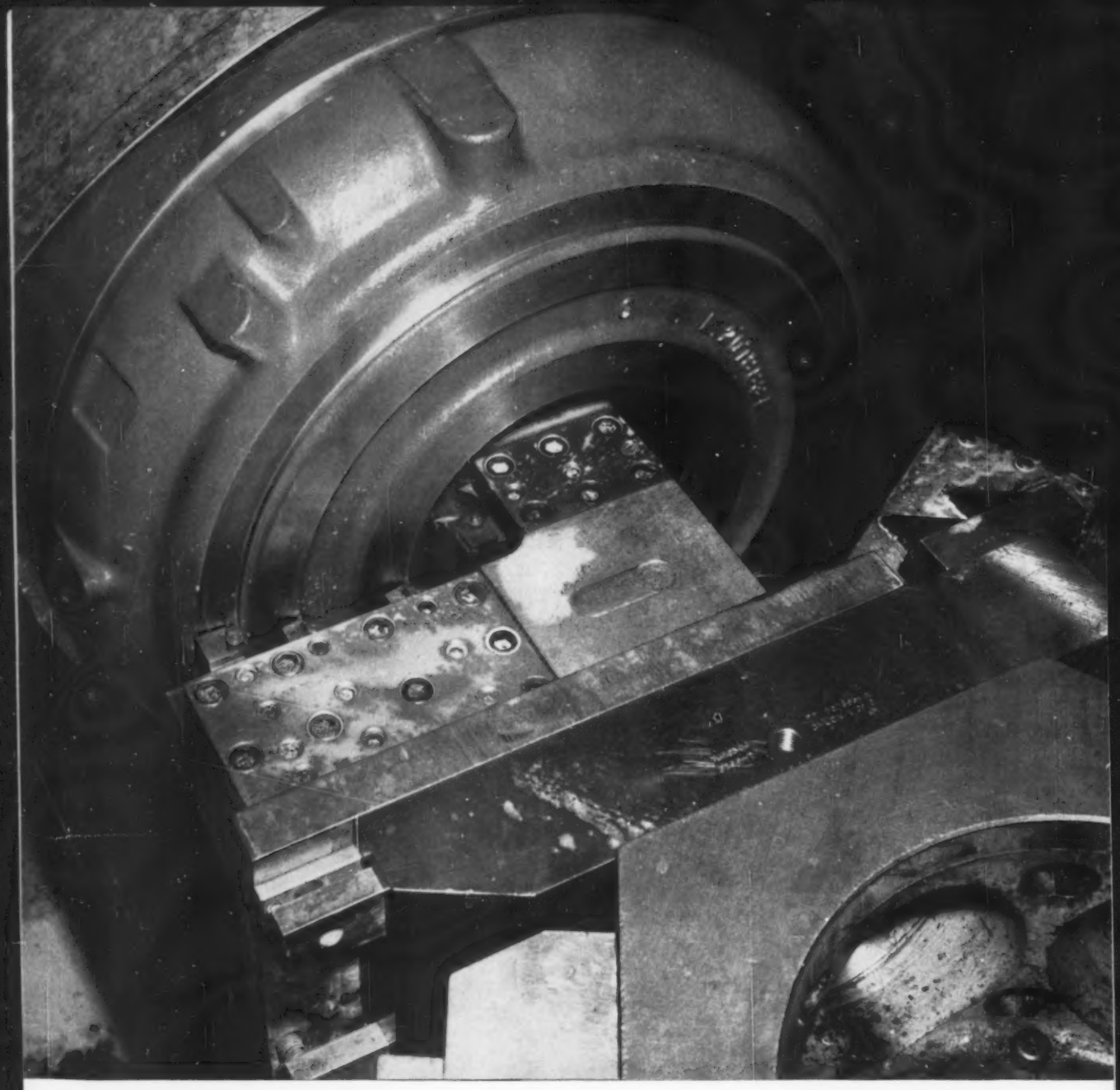
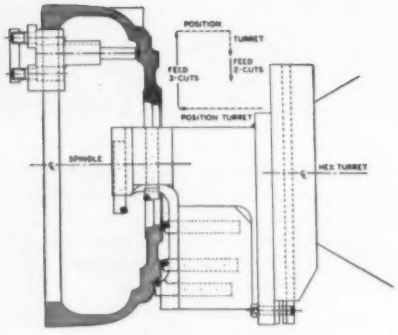
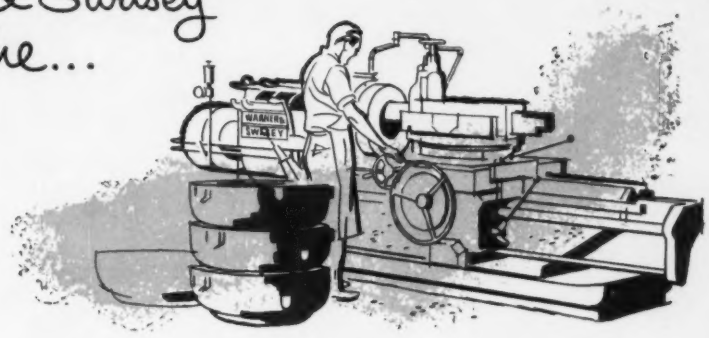




Five cuts with only two machine settings are accomplished with simple multiple tooling and the four-way feeding motion of the cross sliding hexagon turret. (In this station only the "in-and-out" cross feeds are used.) Note the unique tool block adapters mounted on the hex turret. They permit "pre-set" cutter blocks to be quickly and accurately positioned—allow a wide range of similar parts to be machined in small lots with a minimum of setup time—and provide a high degree of interchangeability between setups on the same machine or from one machine to another. General use of "throw-away tips" keeps downtime for cutter replacement to a minimum.

At left: Schematic diagram of above operation shows multiple cutter block tool layout, turret positioning and feed direction, and holding method for the turbine housing.

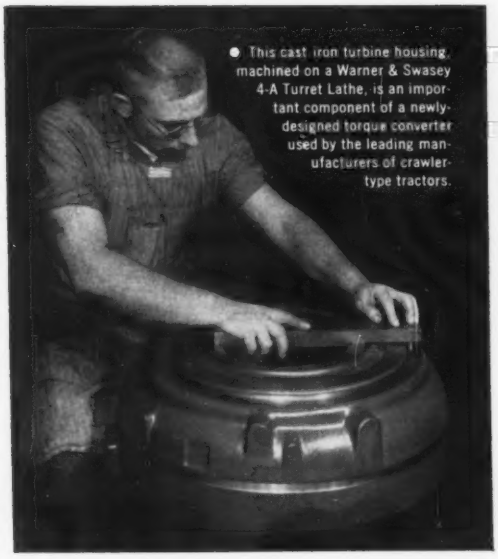
On this Warner & Swasey 4-A Turret Lathe...



FOUR-WAY FEEDING MOTION

of Cross Sliding Hexagon Turret

- **PERMITS SIMPLER MULTIPLE TOOLING—GREATER FLEXIBILITY**
- **REDUCES BOTH MACHINE HANDLING AND CUTTING TIME**



● This cast iron turbine housing, machined on a Warner & Swasey 4-A Turret Lathe, is an important component of a newly-designed torque converter used by the leading manufacturers of crawler-type tractors.

Machine handling operations were cut in half—from 14 to only 7—in the production of these complex 26½" diameter turbine housings. In addition, the efficient utilization of the simpler "multiple-cut" turret tooling by the versatile four-way feeding motion of the cross sliding hexagon turret made significant reductions in cutting time.

As a result, floor-to-floor time was reduced 28%—from 41.7 to 30.0 minutes. This work was formerly run on vertical and "fixed-center" turret lathes.

Handled in 100-piece lots on their two new Warner & Swasey 4-A Saddle Type Turret Lathes, bore tolerances of .002-inch total are easily held along with concentricities of .005-inch T.I.R.

Note these cost-cutting advantages of the cross sliding hexagon turret attachment:

1. *Simpler, less expensive tooling accomplishes special purpose tool results on complex parts.*
2. *Provides the reach necessary for turning, multiple facing and boring a full range of large diameters, including deep bores, back faces, recesses and tapers.*
3. *Lower setup time—hence small lots are practical.*
4. *Versatility—can be inexpensively tooled for either volume or small-lot production of large, complex parts. It's also readily adaptable as a fixed-center machine for handling routine turret lathe work.*

Your Warner & Swasey Field Engineer will gladly present the complete story of how versatile cross sliding hexagon turret equipped Saddle Type Turret Lathes can handle your more complex turning jobs—faster and more economically. Call him today.

WARNER & SWASEY
Cleveland
PRECISION MACHINERY SINCE 1880

YOU CAN PRODUCE IT BETTER, FASTER, FOR LESS...WITH A WARNER & SWASEY

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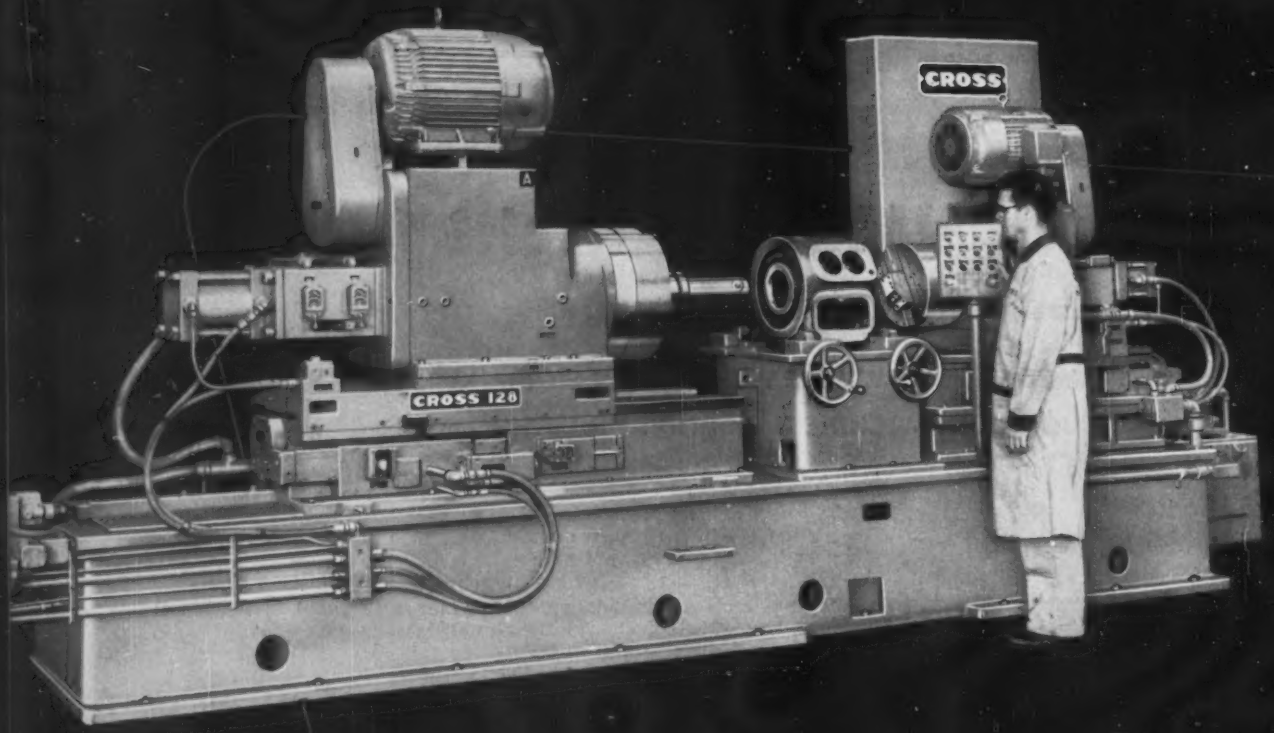
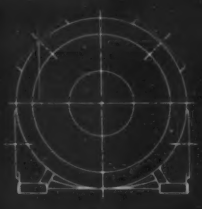
Automation for Short Run, Low Volume Production

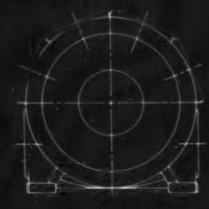


PRODUCT MIX



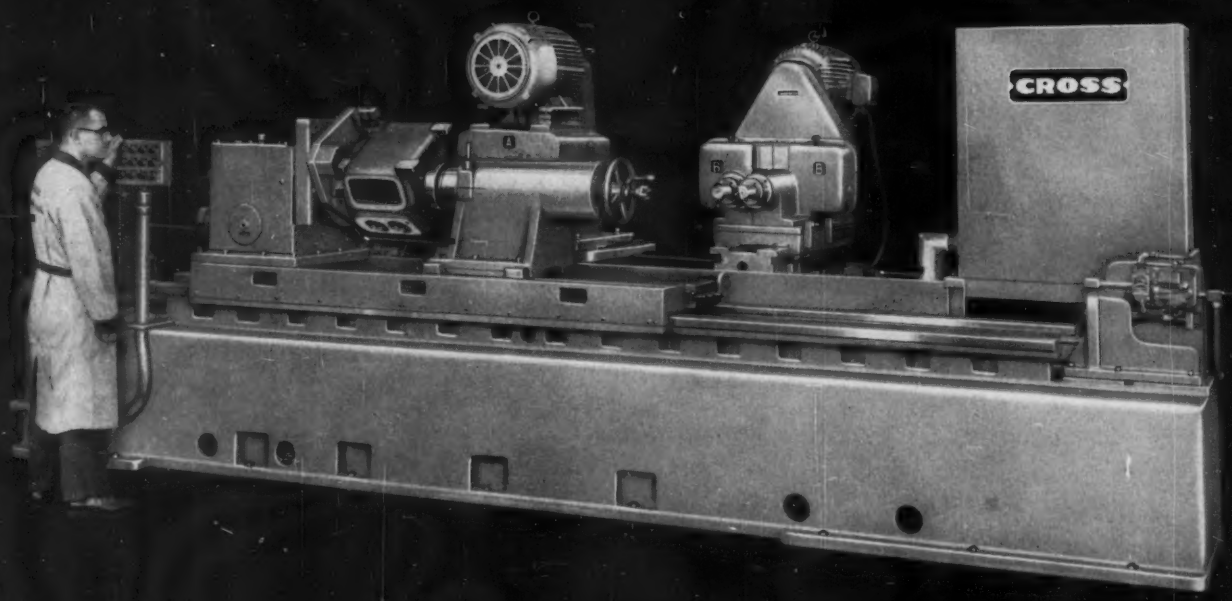
Two-bank compressor for several 4 cylinder models.

Three-bank compressor for several 6 cylinder models.



Four-bank compressor for 8 and 12 cylinder models.

More Specials by Cross



Featuring a high degree of precision, processing versatility and machine flexibility, these two new Cross machines process a complete product mix of 4, 6, 8 and 12-cylinder hermetic compressor housings in lots of 50 each. The two-way boring and facing machine rough and precision finishes crankshaft bores, thrust faces and the motor mounting face. The two-station shuttle-type machine rough and finishes all bank faces and cylinder bores.

Both machines provide completely automatic operations including part indexing and shuttle; incorporate automatic lubrication including new methods of lubricating cross facing heads automatically; and both provide optimum flexibility for handling future part design changes including major dimensional variations in the number, diameter and location of cylinder bores.

Both the two-way and shuttle machine combine rugged dependability for heavy stock removal in roughing with a high degree of accuracy for precision finishing. Critical tolerances are held closely; bank and thrust faces relative to cylinder bores are held square within .001"; main bore and cylinder bore diameters concentric within .001"; motor mounting face and crank bore thrust faces held parallel within .001".

The two-way and shuttle machines are smaller and far less costly than a group of standard machines that would be required to perform identical operations without automated features and advantages.

Both machines incorporate standard Cross "Building Blocks" including wing bases and feed units. All standard and special parts are completely interchangeable for easy servicing.

For details on these—and other automated Cross machines for profitable, low volume production, write, wire or phone:

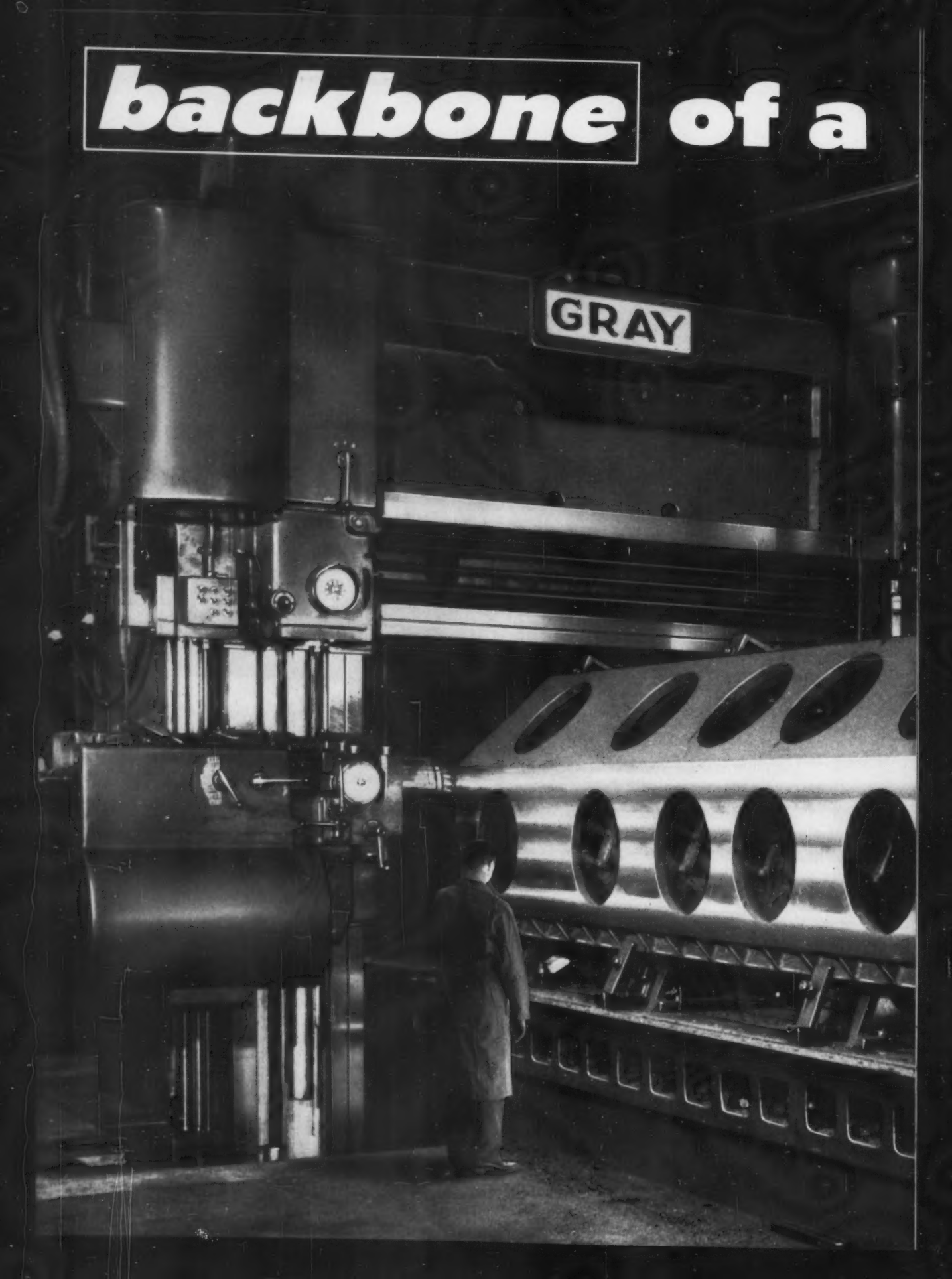
Established 1898

THE CROSS CO

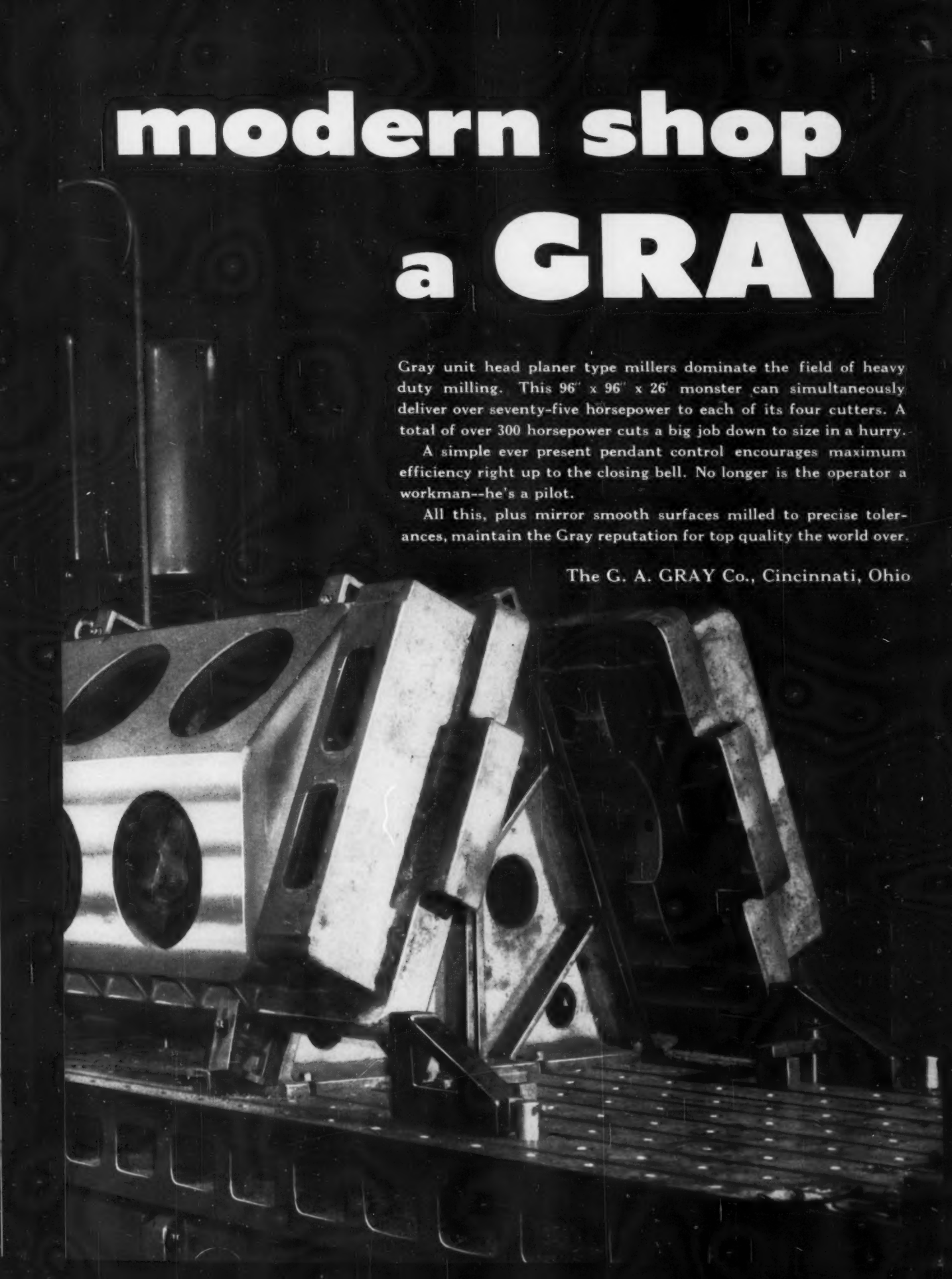
First in Automation

PARK GROVE STATION • DETROIT 5, MICHIGAN

backbone of a



modern shop a GRAY



Gray unit head planer type millers dominate the field of heavy duty milling. This 96" x 96" x 26' monster can simultaneously deliver over seventy-five horsepower to each of its four cutters. A total of over 300 horsepower cuts a big job down to size in a hurry.

A simple ever present pendant control encourages maximum efficiency right up to the closing bell. No longer is the operator a workman--he's a pilot.

All this, plus mirror smooth surfaces milled to precise tolerances, maintain the Gray reputation for top quality the world over.

The G. A. GRAY Co., Cincinnati, Ohio

PORTA-CHECK®
A transistorized portable comparator for fast accurate measurement in both "tenths" and "thousandths" scales.

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Masters of Measurement...

For more than half a century, Ames measuring instruments have been regarded as the finest made. Today the constantly growing line of Ames indicators, gauges, micrometers and comparators includes such amazingly accurate instruments as the new Ames "PORTA-CHECK", an electronic comparator which gives accurate readings *in millionths of an inch*; and the new Model AG air gauge—also accurate to millionths of an inch. Wherever precision is *really* important . . . you'll find Ames "masters of measurement" on the job.

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For checking diameters, dimensions, roundness, etc.

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200 SERIES MICROMETER DIAL INDICATOR
One of four sizes. Made to AGD specifications.

NO. 2 DIAL COMPARATOR
For desk, bench or at-the-machine inspection of small parts.

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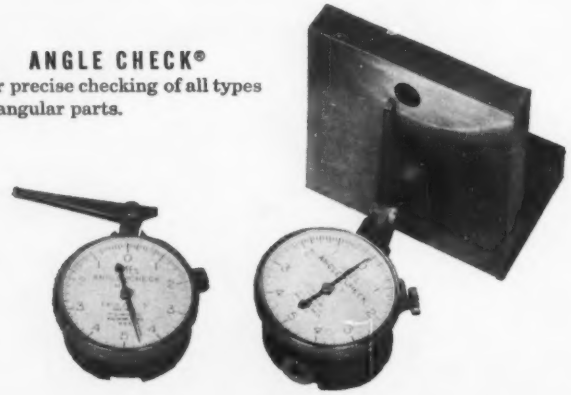
For precise checking of all types of angular parts.

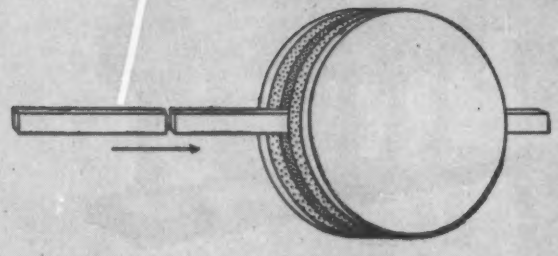


Disc grinder finishes two parallel surfaces in one operation

... Gardner grinder with feed thru work fixture

- gives continuous high production
- assures lowest unit grinding cost
- grinds to precision tolerances

Gardner 2H30 precision double spindle grinder with feed thru fixturing



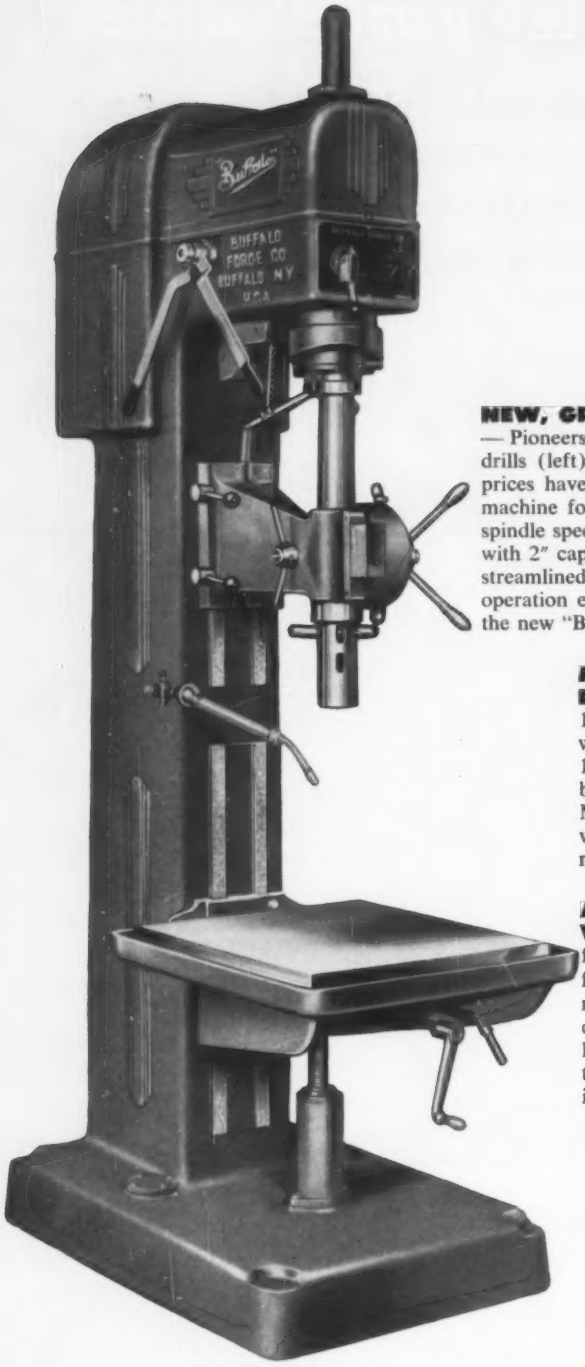
Feed thru double disc grinding

Typical parts:	bearing races, covers, plates, runner bars
Production:	2000 to 6000 parts per hour
Stock removal:	.010" to .020"
Flatness:	.0001" to .0006"
Parallelism:	.0001" to .0007"
Uniformity:	.0008" to .001"

GARDNER

precision disc grinders

BELOIT, WISCONSIN



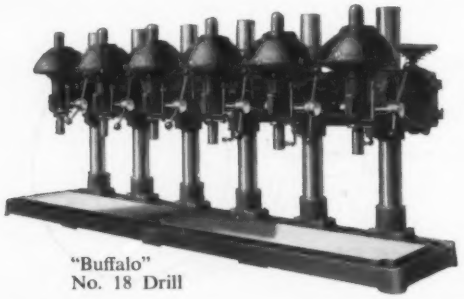
"Buffalo" R-P-Mster

WHICH OF THESE
BELONGS IN

NEW, GREATER CAPACITIES IN THE LATEST "R-P-Msters" — Pioneers in variable speed drilling machines, "Buffalo" "R-P-Mster" drills (left) are newly redesigned to bring you greater capacities. And, prices have been revised to bring you a pleasant surprise! This is the machine for high-speed, accurate production drilling, providing infinite spindle speed changes between 75 and 1300 RPM in the No. 3A Model with 2″ capacity. The new, higher capacity "R-P-Msters" have the same streamlined design, rugged and massive construction and the smoothest operation ever built into a drilling machine. Get the complete facts on the new "Buffalo" "R-P-Mster" Drills. Use convenient coupon.

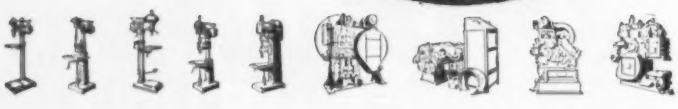
MULTIPLE OPERATIONS SPEEDED BY HEAVY-DUTY DRILL. Powerful and rigidly-built, the "Buffalo" No. 18 Drill is designed to help operators turn out better, faster work. Operation is simple; adjustments are easy. Choose from 19 models to suit your drilling needs exactly — single spindle bench or floor models and multiple units up to six spindles. Minimum deflection is the result of 6-spline alloy steel spindles which turn smoothly on precision ball bearings. Select the models best fitted to your needs — use handy coupon.

A "STAND-OUT BUY" FOR GENERAL SHOP WORK. The "Buffalo" No. 16 Drill offers you more quality features than any machine in its price range: 4 rates of power feed — 5-speed V-belt drive — hardened tool steel clutch members. These features are bound to lower your production costs — through faster and easier drilling, longest useful tool life and peak accuracy. Available in bench, floor or pedestal types, and in multiple units up to six spindles. For complete information on the "Buffalo" No. 16, mail coupon.



"Buffalo"
No. 18 Drill

ESTABLISHED 1877
"Buffalo"
MEMBER N.M.T.B.A.



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440 Broadway

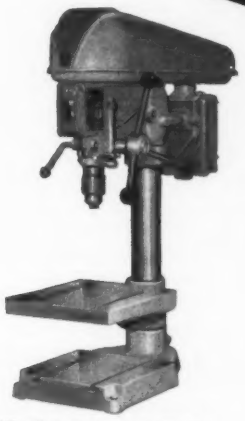
Canadian Blower & Forge Co., Ltd.,

DRILLING PUNCHING

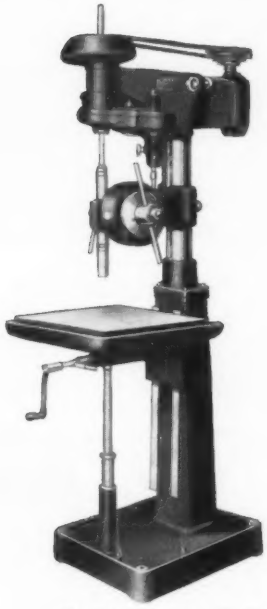
"BUFFALO" DRILLS YOUR PLANT?

NEW FEATURES MAKE A FINE DRILL BETTER. Reports from users of the new "Buffalo" No. 15 Drill are beginning to come in to us. Owners, shop foremen, operators are all enthusiastic. They like the many design improvements which result in easier, faster operation, flexibility and a minimum of maintenance. Although unusually sensitive, the No. 15 is ruggedly built for full capacity operation without wear or strain. The new line includes bench, floor and pedestal models from 1 to 6 spindles. For complete data on the "Buffalo" No. 15 Drill, check and mail handy coupon.

"Buffalo" No. 22 Drill



"Buffalo" No. 15 Drill



"Buffalo" No. 16 Drill

HIGH PRODUCTION, COMPLEX DRILLING OPERATIONS PERFORMED FASTER—With batteries of multiple-spindle "Buffalo" No. 22 Drills (above). The operator of each bank can handle 2 to 4 setups with no stopping for adjustments. These husky, 96-inch high machines operate as easily as smaller sensitive drills, yet have a capacity up to 1¼" in mild steel. No wonder operators are enthusiastic — each spindle has both power and sensitive feed; all controls are within easy reach. "Buffalo" No. 22 Drilling Machines can add more profitability to *your* shop operations. Check and send coupon to find out *how!*

COMPANY
Buffalo, N. Y.

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SHEARING BENDING

BUFFALO FORGE COMPANY
440 Broadway • Buffalo, N. Y.

Please send me additional information on the following "Buffalo" Drilling Machines:

☐ **No. 22** ☐ **"R-P-Mster"**

☐ **No. 18** ☐ **No. 16** ☐ **No. 15**

NAME ..... **TITLE** .....

FIRM .....

ADDRESS .....

CITY ..... **STATE** .....

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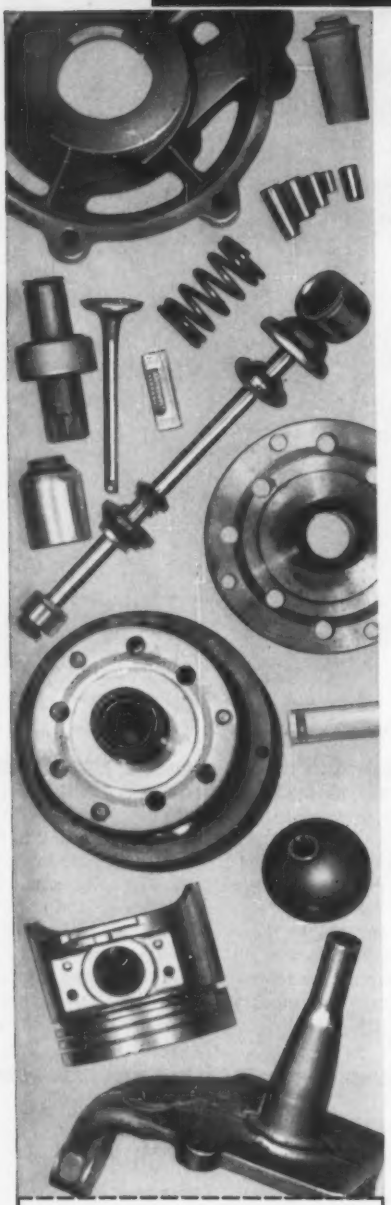
practical automation ideas ....#2



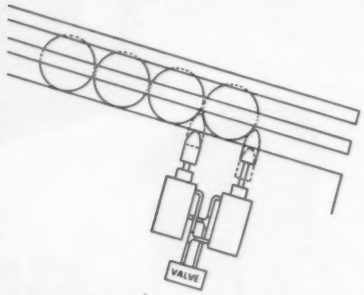
Why Waste Floor Space?

Often a Gear-O-Mation 'overhead' demand storage unit can provide all the in-process storage and demand feeding you need. Can be used between widely separated operations. Tracks of unit are self-cleaning to avoid maintenance up under the ceiling.

Want to see Gear-O-Mation's "Idea File"? Every Gear-O-Mation field engineer has one. Drop us a line and we'll tell the one handiest to your company.

Two Cost Less Than One

Simple twin air cylinders, working alternately can release parts for demand feed at a lower cost, frequently, than a single cylinder with a rocker



arm. The arrangement is also more positive and can give faster 'in' and slower 'out' movement to prevent parts jamming or accidental escape.

The Old Town Pump

Many practical automation ideas come from old principles. Example: Use of the old town water pump to elevate parts on demand. Instead of bringing up water, a cage instead of a plunger brings up a part. The cage opens the gates. Elevation is by a simple piston rod.

When it comes to actuating devices —electrical, mechanical, hydraulic or pneumatic—it is Gear-O-Mation's policy to use only proven equipment, thus lessening chances of service interruptions and making sure reliability is not sacrificed.

"Freeway" Interchange for Parts

If you have the need to switch parts on demand from, say, either of TWO 'inbound' to either of two 'outbound' tracks, Gear-O-Mation has a simple way of doing it with air operated gate. Particularly useful where you are feeding two machines from two others.

Flip-Flop Press Feeder

An oscillating arm with built-in hydraulic clamp can pick up a part from the loading chute, load it into a press, reverse it, remove it and place it on the unloading chute or conveyor.

A basic principle at Gear-O-Mation is to look always for the simplest answer to any problem of handling of parts in process. Usually they find it, too. Nine times out of ten, the simplest way is usually the most practical.

2-Strand Chain Does Whole Job

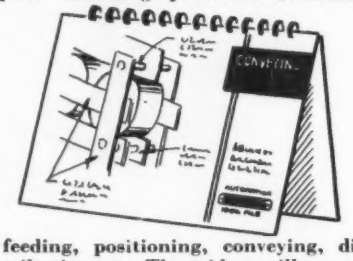
Rotating continuously in a vertical plane, a 2-strand chain with A, B and C pockets receives parts, feeds them into machine 'A' for operation 'A', takes them back, feeds them into machine 'B', gets them back again, feeds them into machine 'C'. Exit chutes into machines serve as loading magazines.

Automating for Worker Safety

Positioning of small parts in relation to large ones in welding or riveting machines sometimes presents a safety hazard to hands. A simple solution is a positioning arm with a formed end which swings into place by simple cam action after the large part is inserted. The small piece is then pushed into position by the machine and the positioning arm retracts, leaving the part in place.

SEE THIS "IDEA FILE"

Every Gear-O-Mation field engineer now carries with him an "Automation Idea File." It contains sketches and details of practical answers to many parts handling problems—orienting,



feeding, positioning, conveying, distributing, etc. These ideas will suggest variations to suit your exact needs. Have a Gear-O-Mation field engineer go through the "Idea File" with you soon! Use the handy coupon at left.

GEAR-O-MATION
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7171 E. McNICHOLS RD. • DETROIT 12, MICH.

GEAR-O-MATION
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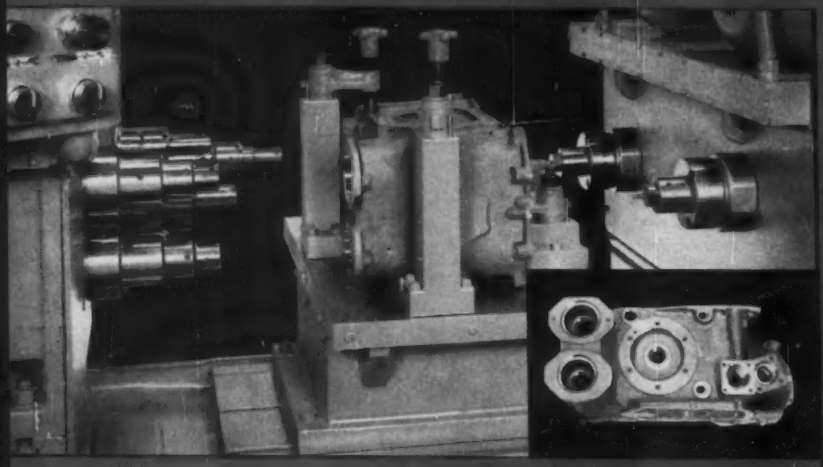
7171 E. McNichols Rd., Detroit 12, Mich.

Yes! I want to see the time- and money-saving ideas in your new "Idea File." Have your field engineer show it to me soon!

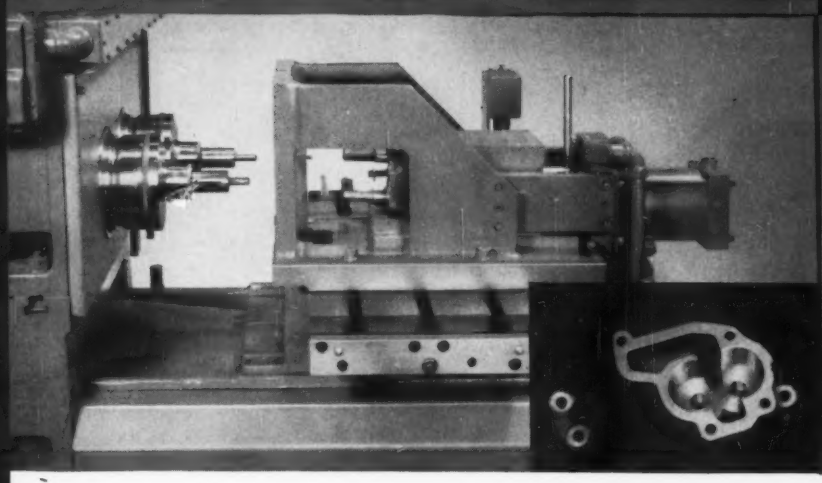
Name_____
Company_____
Street_____
City_____

Standard Ex-Cell-O Precision Boring Machines



. . . FOR FASTER MULTIPLE-HOLE WORK

Standard style 17-A performs 26 operations in one cycle on a magnesium aircraft casting. Machine bores five bronze bushings, counterbores seven diameters, faces four surfaces and chamfers eight shoulders with five spindles at left, two spindles at right.



. . . FOR FASTER CLOSE-TOLERANCE WORK

Style 112-D finish-bores gear pockets and shaft holes, and plunge-faces pocket bottoms of oil pump bodies to tolerance of plus or minus .0005". Flat faces are square to the bores and parallel to each other within working limits of .001".

59-17

10 REASONS WHY EX-CELL-O PRECISION BORING MACHINES DO MORE, AT LESS COST!

1. RUGGED—Heavily-ribbed base castings, chatter-free hydraulic-actuated table movement, isolated power assembly.
2. FLEXIBLE—Bridges easily spaced-out for large work, moved in for smaller parts.
3. VERSATILE—Inbuilt versatility, plus Universal Fixtures for toolroom work, short-run and production jobs. Spindles mount in any position.
4. FAST—Rapid table traverse, positive spindle brakes and quick-load fixtures for high output.
5. LOW TOOLING COST—Standard machine components, tools and accessories cut lead time, speed setup.
6. AUTOMATIC LUBRICATION—Separate lubricating system pumps oil directly to the ways.
7. SEALED SPINDLES—Ex-Cell-O Precision Spindles permanently lubricated during assembly.
8. CONVENIENT CONTROLS—Easy to use hydraulic controls contained in a single panel.
9. TROUBLE-FREE—Vital machine parts and controls protected from dirt, chips, coolant. Ready access to components for inspection.
10. CAMS FOR CONTOURING—Cam-operated boring machines available for precision contouring work.

Call your local Ex-Cell-O Representative, or write direct for complete details on the full line of Ex-Cell-O Precision Boring Machines.

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EX-CELL-O CORPORATION Machinery Division
DETROIT 32, MICHIGAN

MANUFACTURERS OF PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • TORQUE ACTUATORS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • THREAD AND GROOVE GAGES • GRANITE SURFACE PLATES • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

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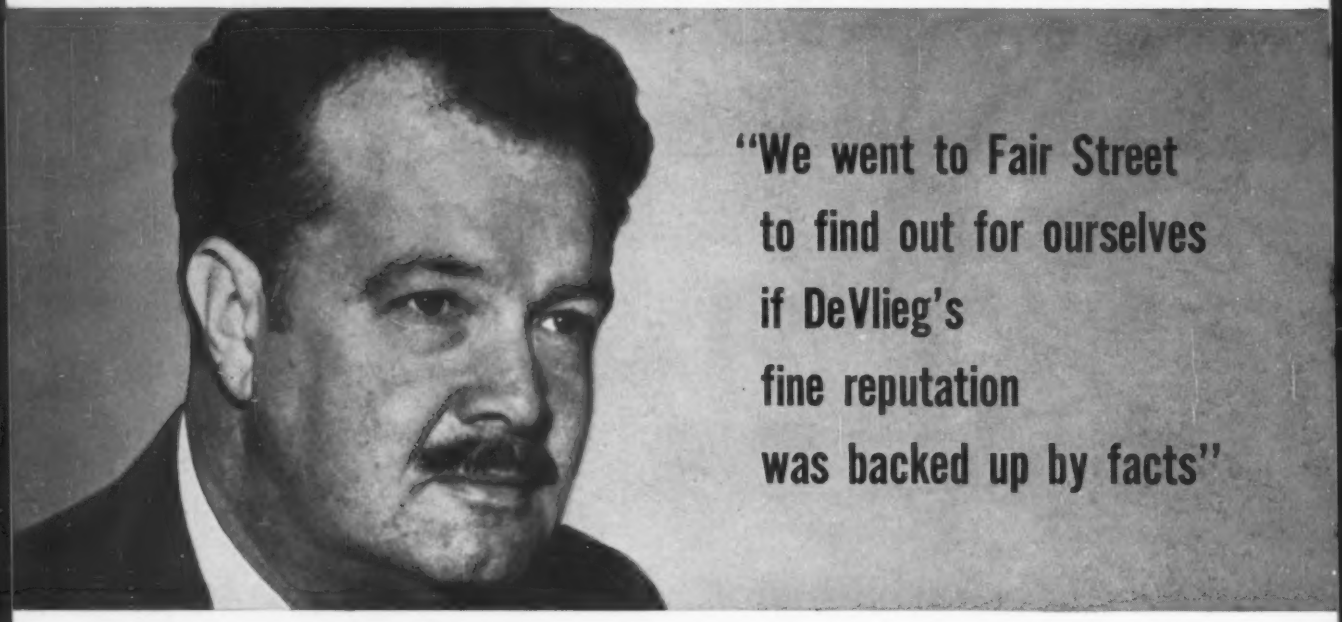
GUSTAV VON REIS, President
Detroit Broach & Machine Co.

a man who came to Fair Street



"We were convinced. We purchased two JIGMILS and they have now been in operation for several years. These machines have all the fundamentals required to produce the highest degree of accuracy, and yet, are simple to operate. Besides this, and we feel most important of all, the JIGMIL has special features which largely eliminate our reliance on the human element to produce close tolerance work. JIGMILS enable us to produce our broaching machines and broaching tools to the very highest degree of accuracy, a matter of the utmost importance in our products."

GUSTAV VON REIS

DE VLIEG MACHINE COMPANY, FAIR STREET **ROYAL OAK, MICHIGAN**

SOME OF OUR JIGMIL USERS

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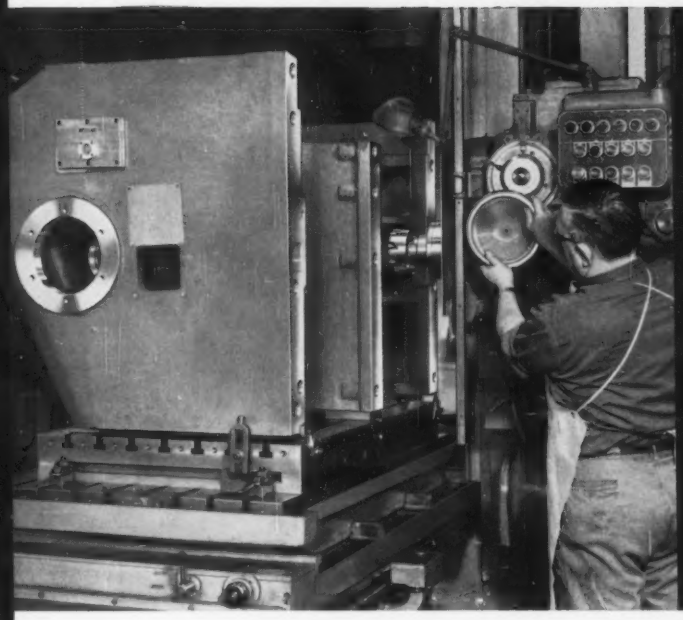

A FEW PROVEN ADVANTAGES OF THE JIGMIL TECHNIQUE

- Eliminates cost of expensive jigs and production delays resulting from their manufacture.
- Simplifies tooling.
- Employs automatic functions to reduce factors of human error even in close tolerance work.
- Makes possible greater flexibility of product design.
- Improves end product by permitting interchangeable assembly of parts without hand fitting.
- Increases production and product accuracy.

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JIGMIL—EXTREME ACCURACY ON LARGE, WEIGHTY PARTS FOR DETROIT BROACH

Broaching machine knee, 65″ long, weight 5500 lbs., set-up on a 32″ x 60″ index table on a Model 4B-72 JIGMIL. The knee is rough and finish milled, bored, drilled and tapped from four sides in one set-up. Formerly machined on a conventional boring mill, the job took 120 hours. The JIGMIL now completes all machining operations in 50 hours with consistent accuracy and without special tooling. Furthermore, the accuracy achieved effects substantial reductions in assembly time and improves the quality of the end product.

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Welding manganese steel casting of Renner dipper to ManTen plate with Airco Easyarc 308 — the electrode welders prefer. It not only turns out a crack-free weld, but its operation is smooth and uniform, and restriking characteristics are excellent.

how Renner **PUTS THE BITE ON PRODUCTION COSTS** with **EASYARC 308**

Fast-growing Renner Manufacturing Company holds down the cost of fabricating Renner dippers . . . avoids the problem of preheating weldments . . . and, at the same time, produces crack-free welds. Renner uses Airco's new Easyarc 308 AC-DC metal powder electrodes.

Easyarc 308 lowers production costs because it costs less than conventional stainless electrodes. It lays down a fine looking stainless steel deposit with only a small amount of slag that can be removed easily without a chipping gun. And it delivers a high quality weld.

Other uses. On all high carbon steel applications, wherever there could be the slightest chance of cracking, Renner relies on Easyarc 308.

Do you have competition? The lower production costs possible with Easyarc 308 can help you to compete more effectively. Investigate Easyarc 308 . . . the new stainless electrode at low cost. Phone your Authorized Airco Dealer. He's listed in the Yellow Pages under "Welding Equipment and Supplies." Or, contact Airco direct. Ask for Catalog 1318.

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A FULL LINE OF EX-CELL-O PRECISION TOOL GRINDERS

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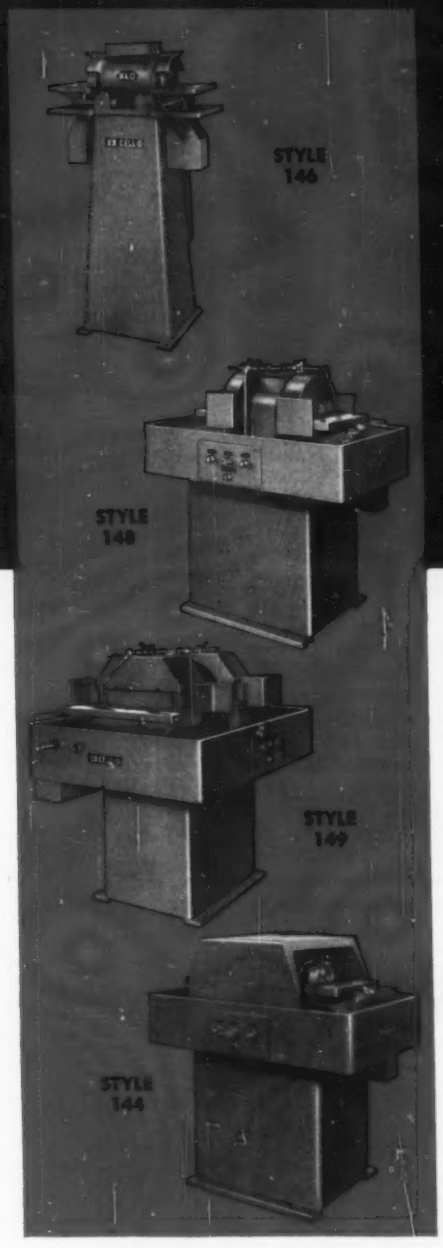

Ex-Cell-O Precision Tool Grinder line includes: Style 264 (above), an electrolytic reciprocating model for lower-cost sharpening of carbide tools, and the similar Style 142 (not shown) for conventional grinding; the Style 146 finish grinder, which uses 6" plate-mounted wheels; Style 148, which uses 10" wheels for roughing and finishing larger tools; the Style 149, with 14" grinding wheels and heavy-duty Spindle; and the Style 144 finish grinder with Ex-Cell-O Precision Spindle. Style 264 and 142 provide automatic reciprocation for face grinding, and manual reciprocation for grinding chip breaker grooves.

59-26

For toolroom economy, efficiency and production

Since 1932, Ex-Cell-O Precision Tool Grinders have saved time, increased production and improved toolroom accuracy in sharpening flat and dovetail forming tools; grinding single-point lathe, planer, shaper and boring tools; plunge grinding chip-breaker grooves; and sharpening solid carbide, carbide-tipped, alloy and high-speed steel tools.

For help in selecting the model with the features you need for faster, better tool grinding at lower cost, call your local Ex-Cell-O Representative, or write direct for details on the complete line of Precision Tool Grinders.

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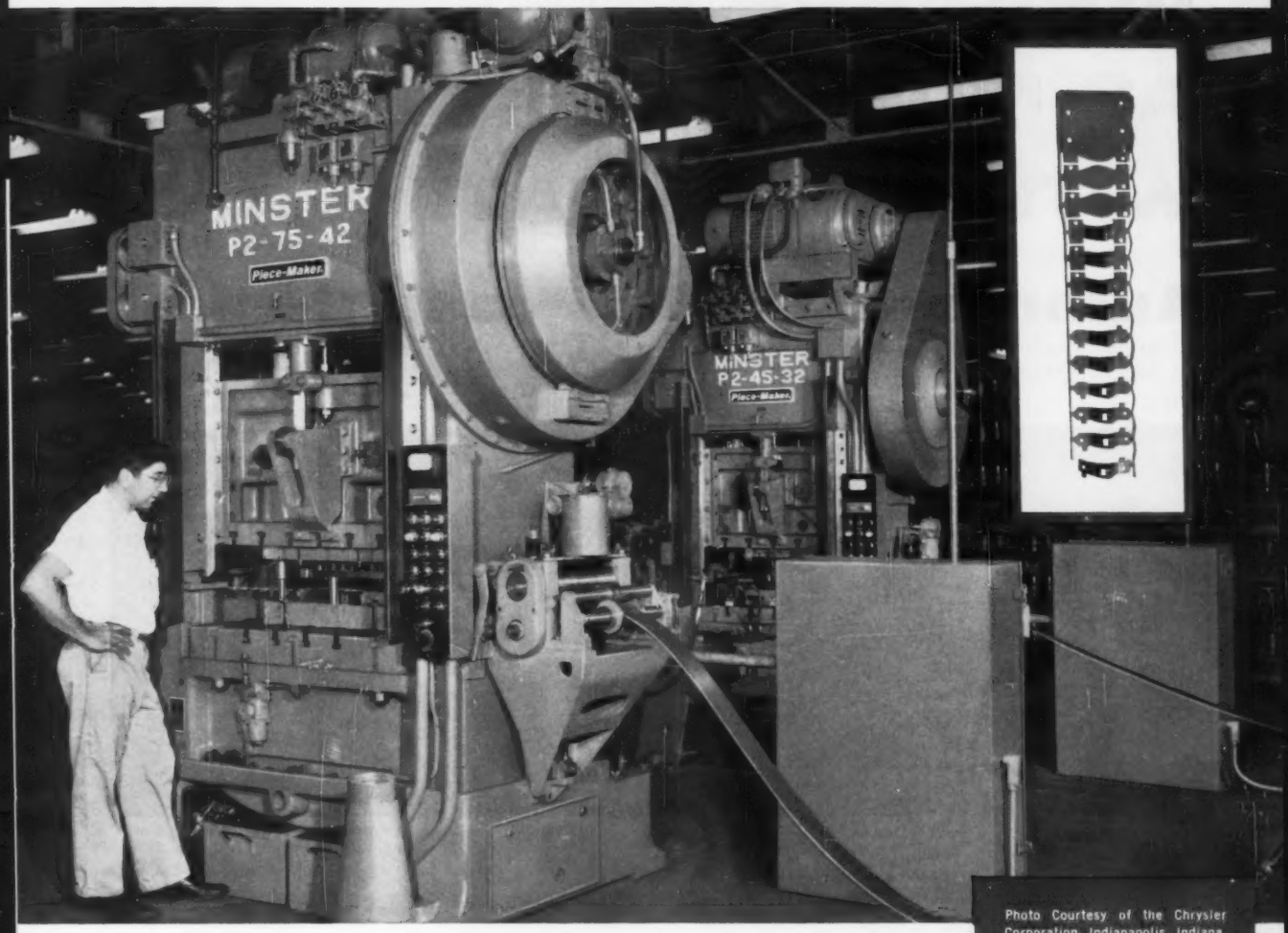

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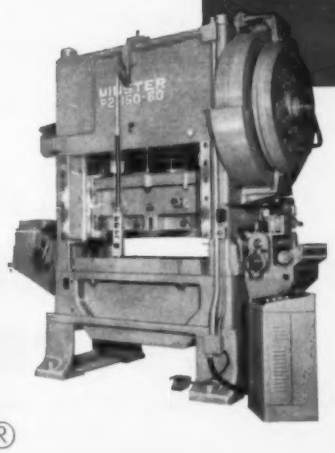

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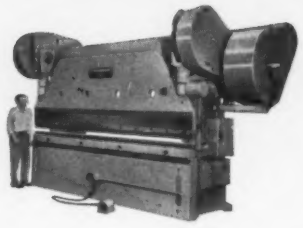
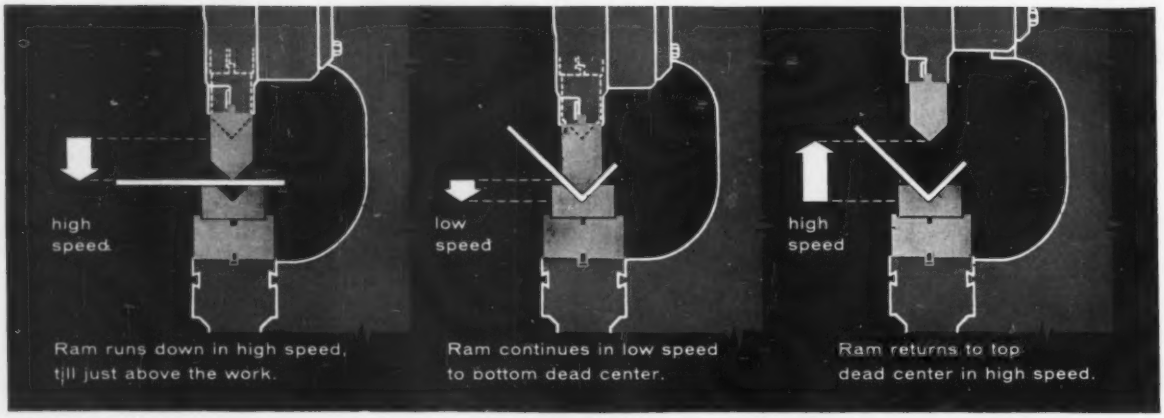


Automatic Cycle Press Brakes


high speed
low speed
high speed
Ram runs down in high speed, till just above the work.
Ram continues in low speed to bottom dead center.
Ram returns to top dead center in high speed.

If you form long, flexible parts, you can increase your production up to 60% with a Cincinnati Automatic Cycle Press Brake.

A new, exclusive feature, the Cincinnati Automatic Cycle provides a combination of instantaneous fast and slow ram speeds with every stroke. As a result, you get maximum production speed without the "whip up" and "back bending" which often occur in high speed forming of long parts which have no beam strength.

You no longer have to rely on the operator's skill at clutch slipping to obtain parts that are free of "back bends."

You can get this money-making feature on all new 7 and 9 Series Cincinnati Press Brakes.

This productive new feature means a lot of advantages for you:

1. Job records show 10% to 60% increase in parts formed per hour.
2. Low speed portion of the ram stroke can be set so that all strokes are identical in length.
3. Rejects caused by "back bends" are stopped.
4. Highly experienced operators are not required.
5. Operator fatigue is greatly reduced because there is no need for clutch slipping.
6. Clutch and brake are long-life, minimum-maintenance units requiring no adjustments.

Write Dept. D for full details about the Cincinnati Automatic Cycle, Bulletin B-9R.

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More cost-cutting IDEAS— to help you

PHOENIX CUTS COSTS BY MACHINING PIPE FLANGES IN ONE OPERATION

Back-facing attachment on Simplimatic saves operation—machines both ends in one chucking

You'll want to remember this setup. It shows how Phoenix Manufacturing Company, a division of Union Tank Car Company, Catasauqua, Pennsylvania, cut machining time on *tough* steel pipe flange forgings.

Workpieces include welding necks, slip-ons, threaded (less threading) as well as blind pipe flanges. These parts, with bores ranging from 3″ to 16″, are machined in lots of 25 to 2000 pieces. A back-facing attachment saves time, operations and handling by permitting machining of both ends in one chucking. The entire range is handled with one basic setup on the Gisholt MASTERLINE Simplimatic Automatic Lathe.

Built for rugged cuts, the rigidly tooled Simplimatic offers added time savings because higher cutting speeds and feeds can be used. Here *machining is based on an average boring speed of 450 surface f.p.m. at .0156″ feed per spindle revolution, on all part sizes!*

Change-over is especially fast and easy. Pick-off gears provide the new spindle speed. Chuck jaws, tools or holders are adjusted or replaced. *A slide base, machined into the platen table*, and an attached scale permit rapid front tool slide adjustment for various bore diameters. Fine adjustment is obtained by a micrometer screw on the tool block.

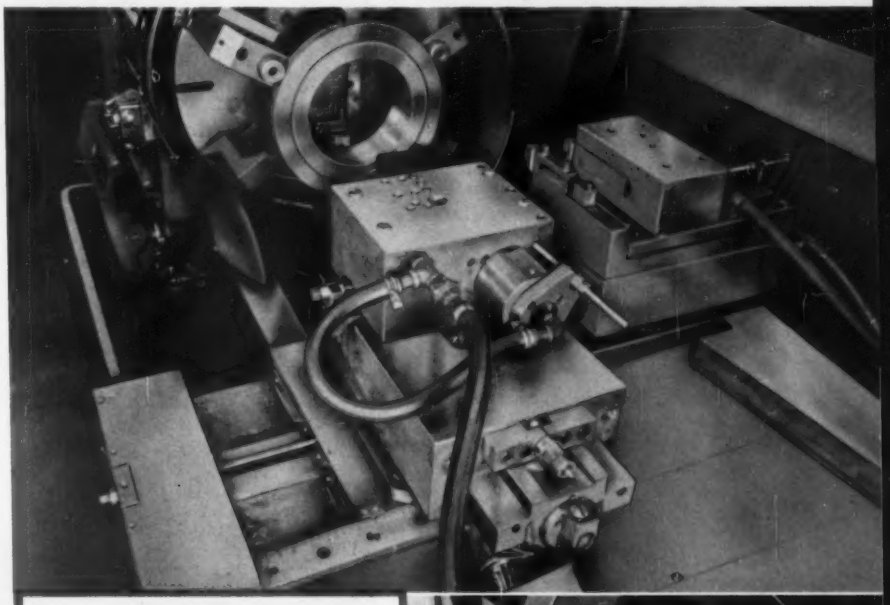
The Simplimatic is shown set up for a 10″ welding neck flange with a 16″ flange O.D. and a 10″ bore.

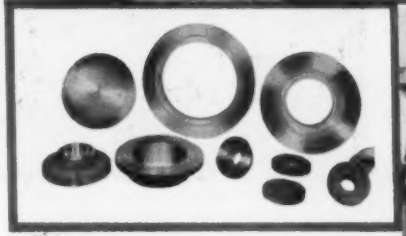
Work locates against the back of the flange face and is held on the flange O.D. in a 28″, power-wrench-operated, 3-jaw scroll chuck. Front slide tools rough- and finish-bore and form grooves or gasket seal serrations on the flange face, while two tools on the rear slide step-face the flange. As the boring and facing tools reverse-traverse, the back-facing attachment faces and chamfers the neck, completing the operation.

Approximately ½″ stock is removed in the boring and ¼″ stock removed in the facing operations, totaling 23 pounds. A 125 to 150 micro-inch RMS finish is easily maintained by machine and tooling rigidity and a 2-speed motor. This provides a low speed for grooving or serrating and a high speed for all other operations.

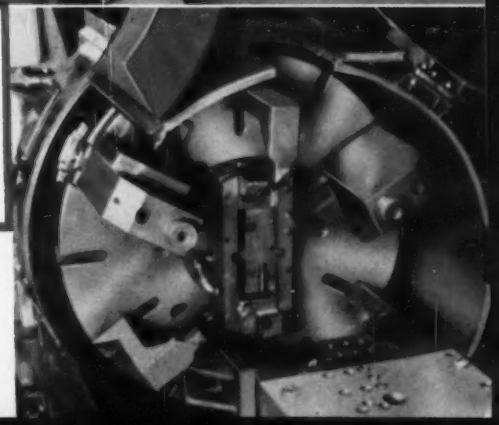
Special slide base, machined into the platen table, speeds front tool slide setting. Back-facing attachment saves additional operations, handling; assures concentricity between back face and bore, parallelism between front and back faces.

Ten-inch welding neck flange and tooling. Back-facing attachment is visible through the workpiece bore. Note the special slide base (at the lower left), machined into the platen table, for quick front tool slide adjustment.





A few of the various tough steel pipe flange forgings handled on this Simplimatic. Welding neck flange featured in story is in bottom row, second from left.



Back-facing attachment and chuck.

HOW UNITED ENGINEERING CUTS TIME 30% ON 4000-LB. JOB

Duplex chucking on rigid, versatile 5L speeds machining, increases accuracy

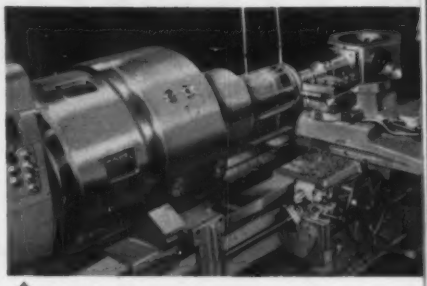
If your work involves massive parts, heavy stock removal and close tolerances, keep this setup in mind. It shows that the rugged Gisholt MASTERLINE Saddle Type Turret Lathes provide the power, rigidity and versatility to handle problem parts at top efficiency.

Here United Engineering and Foundry Company, Canton, Ohio, has cut journal machining time 30% or more on 2-ton alloy iron "peanut" rolls. A fixed-center, 5L Saddle Type Turret Lathe is used. A 60" extended bed and a 12½" spindle bore accommodate the work. Electric controls handle braking, spindle jogging, motor forward and reverse. Pedestal-mounted duplicate controls (not shown) permit the operator to remain in a normal working position throughout machining.

A special duplex chucking fixture grips on the midsection of the roll body. This fixture consists of two 32", 3-jaw, self-centering chucks attached to opposite sides of an intermediate body. This assembly mounts on an adapter that fits the 20"-A1 spindle nose. There are no bearing problems since the 5L headstock has the rigidity to prevent spindle and fixture deflection despite an estimated 18,000 inch-pound bending moment exerted by the 4000-lb. workpiece and fixture.

A turret-mounted revolving center provides work support at the outer end. Machining includes turning two diameters, 11 $\frac{31}{32}$" x 17⅞" long, 10 $\frac{31}{32}$" x 1⅛" long—forming a groove 1¼" wide by ⅜" deep, and an $\frac{11}{16}$" radius to blend the journal with the main roll body—and chamfering. The roll is then turned, end for end, to machine the opposite journal. Both ends are machined, with 325 pounds of tough alloy iron removed, in just three hours and 45 minutes, f.t.f. time.

Duplex chucking fixture simplifies job. Rigid 5L construction prevents deflection that could be caused by an estimated 18,000 inch-pound bending moment exerted by 4000-lb. workpiece. Simple tooling completes part in 30% less time.



Close-up of duplex chucking fixture, extending 32" from the spindle and offering chucking capacity of 17¼" up to the spindle, 12½" through the spindle.

Two-ton alloy iron "peanut" roll handled with this setup. 325 pounds of stock removed in machining both journals in total floor-to-floor time of three hours and 45 minutes.

SETUP SAVES 3 MINUTES PER PART FOR WALWORTH

Two-end machining on No. 5 ram eliminates one operation and extra handling

Here is a new approach that cuts costs of machining large, cast steel, lubricated valve plugs in several sizes. Ordinarily, machining at one end and centering at the other require two chuckings and extra equipment. This setup on a Gisholt MASTERLINE No. 5 Ram Type Turret Lathe, with an automatic drive and a spindle-mounted center-drilling attachment, completes both ends in one automatic cycle. Walworth Company, East St. Louis, Illinois, is the manufacturer.

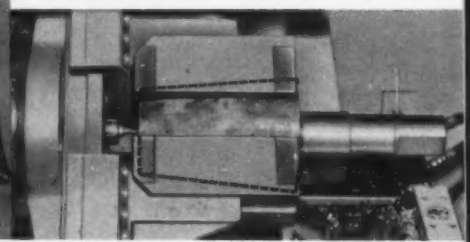
Since the automatic drive converts this ram into an automatic chucking turret lathe, the operator only loads, unloads and chucks. He has ample time to handle a second machine.

Here is the automatic cycle for the first operation on a 4" plug—20⅜" long, 6" maximum diameter. Work is held in a 15", 2-jaw, self-centering chuck. Hex turret tools turn and form the shaft diameters, drill two holes, center and tap in the shaft bore. A rear cross slide tool faces the 6" diameter, blending with the turned shaft. The spindle-mounted center-drilling attachment operates during the automatic cycle, centering the work from the other end. F.t.f. time, 8.4 min.

Tooling setup on 4", cast steel, lubricated valve plug. Part shown just after finish-turning of shaft diameters and facing of plug body from rear of cross slide. Note 2-jaw, self-centering chuck.

Automatic chip clearing in the 11" and 4⅛" deep holes is provided by periodic drill withdrawal. Rapid traverse quickly returns the drill to the hole bottom before feed is resumed. Class 3 threads are assured by the automatic drive. This maintains sufficient pressure on the turret to eliminate possible "drag" and permits the tap to maintain its own natural lead.

Center-drilling attachment permits machining both ends in one chucking, eliminates separate centering, reduces handling 50%. Automatic drive saves time, doubles operator productivity.



Workpiece in 2-jaw, self-centering chuck showing surfaces machined at both ends. Note spindle-mounted center-drilling attachment at left. Dotted lines show outline of plug body.

ASK YOUR GISHOLT REPRESENTATIVE ABOUT FACTORY-REBUILT

BAKER OIL TOOLS, INC., SAVES 35% ON NINE PARTS

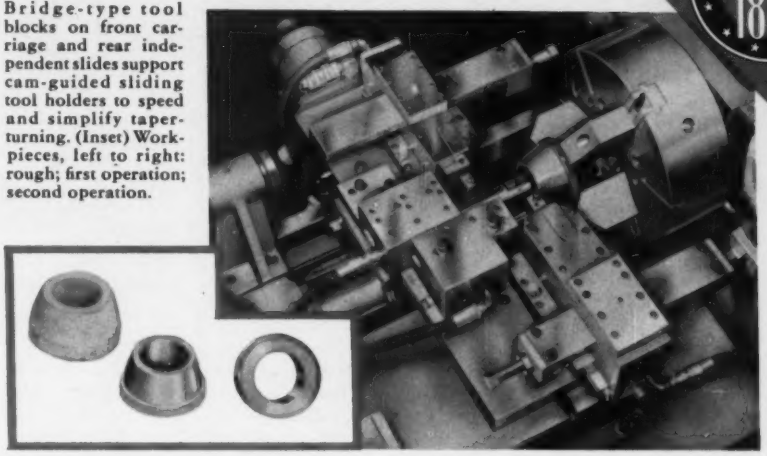
Cam-guided tool holders on No. 12 cut short-run costs

Costs going up on short runs of similar parts? If so, this setup on two Gisholt MASTERLINE No. 12 Automatic Production Lathes will interest you. In use at Baker Oil Tools, Inc., Los Angeles, California, it has cut machining time 35% on nine sizes of cast iron upper cones. These cones are used in bridge plugs and retainer production packers. Lots range from 50 to 500 pieces.

The typical part shown is 2¾" long. The O.D. tapers from 5" to 3¾". Tooling for the first operation (shown) includes special bridge-type tool blocks on the front carriage and rear independent slides. Each block contains a cam-guided sliding tool holder used to turn the 14° tapered cone O.D. Separate, adjustable tool blocks on each slide handle additional surfaces.

Work is located against the back face and held on the O.D. in a 15", 3-jaw air chuck. During the automatic cycle, rear independent slide tools rough-turn the tapered O.D. and shave-face the cone end. At the same time, front carriage tools rough- and finish-bore and chamfer I.D. and O.D. edges while the tapered O.D. is finish-turned. Time, 2.1 min. f.t.f.

For the final operation on the second No. 12, the work is located against the machined face and chucked on an air-operated mandrel.



Bridge-type tool blocks on front carriage and rear independent slides support cam-guided sliding tool holders to speed and simplify taper-turning. (Inset) Workpieces, left to right: rough; first operation; second operation.

Front carriage tools face the end and a co-bore. Rear independent slide tools rough- and finish-turn the straight O.D., radius the O.D. edge, and chamfer the bore and the rim I.D.'s. Time, just .8 minutes f.t.f.

Change-over to accommodate different sizes on either machine requires less than one hour.

Bridge-type blocks with cam-guided tool holders speed taper-turning. No. 12 flexibility permits use of other standard tools that machine additional surfaces, accounting for the 35% time savings.

Versatility offered by No. 12, as demonstrated in this setup, will cut your costs on long or short runs. Contact your Gisholt Representative or write for new No. 12 Catalog, Form 1213.

ECCENTRIC CAMS SUPERFINISHED 25% FASTER BY DENISON ENGINEERING

Superfinishing is not limited to cylindrical bores or round parts

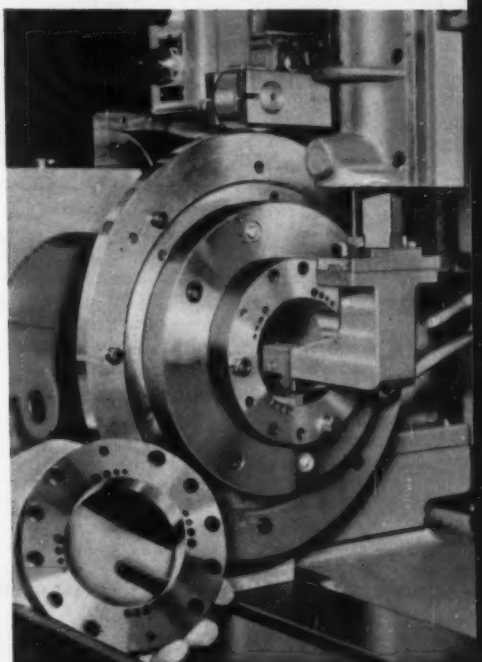
Here smart tooling and machine flexibility provide new economy in finishing the eccentric I.D.'s of hardened steel cam rings. This setup on a Gisholt MASTERLINE 51-A General-Purpose Superfinisher cut finishing time 25%. It also improved quality and lengthened service life on these problem parts for Denison Engineering Division of American Brake Shoe Company, Delaware, Ohio.

Fifty-five different part sizes are handled in lots ranging from 50 to 1000 pieces. Special tooling consists of a spindle-mounted master cam and a cam follower arm, linked to the Superfinish stone-carrying quill. This permits the stone to follow the eccentric cam ring I.D. The headstock is raised to provide 16½" swing for the largest master cam.

Parts are located in proper relation to the master cam by pins on a spindle-mounted face plate. Here is the sequence: The Superfinishing stone moves longitudinally to enter the bore; it then moves down to contact the work I.D. and start the automatic cycle. Constant hydraulic pressure is maintained on the stone. This assures uniform contact with the work I.D. independent of the "rise" and "fall" of the master cam. The stone reciprocates while the work rotates. Surface is reduced from 30-35 to 10 micro-inches RMS (removing only 0.0003" material) in just 1.5 min., f.t.f.

Spindle-mounted eccentric cam with cam follower linked to Superfinish stone-carrying quill cuts eccentric bore finishing time 25%. Superfinish improves quality and lengthens service life of parts.

Ordinarily used for cylindrical or flat work, 51-A Superfinisher with spindle-mounted master cam and follower arrangement Superfinishes eccentric cam ring I.D. Note follower at top of master cam that controls "rise" and "fall" of Superfinishing stone on offset holder.



MASTERLINE GISHOLT SINCE 1887

AUTOMATIC TURRET LATHE SAVES SIX WAYS

Eight-sided turret on Fastermatic saves operations on large parts for Goodyear Aircraft Corp.

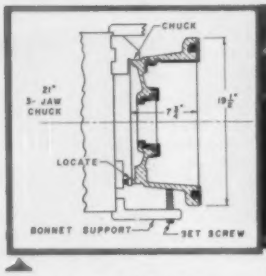
The automatic approach is often overlooked when machining large parts. But, when properly applied, it offers substantial savings in equipment costs, floor space and material handling. In addition, here's how it cut machining time, and improved surface finish and tool life for Goodyear Aircraft Corp., Wheel and Brake Division, Akron, Ohio.

The job: a variety of large magnesium and aluminum alloy airplane wheel halves. Formerly these parts were produced on larger, more expensive, manually operated vertical turret lathes. Now they are machined on a single lower-cost Gisholt MASTERLINE 2F Fastermatic Automatic Chucking Turret Lathe, with 29½" swing to handle the "oversize" parts. An octagon turret carries all tools, eliminating the need for a front and rear cross slide carriage. An automatic chip conveyor reduces chip clearing time and pays off in extra pieces during each work shift.

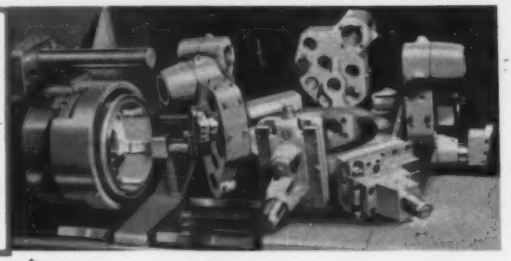
Twenty-two different wheel halves are handled with one basic setup. The 19½"-diameter, 7¾"-wide, inboard wheel half shown is typical. The drawing indicates how it is chucked, located and supported in a special bonnet mounted on the chuck face.

All surfaces shown in black, including severe interrupted and heavy forming cuts, are made from overhead-piloted, multiple-tool holders. Reverse feed eliminates tool tracks and provides a 15 micro-inch RMS finish on critical bearing bore surfaces.

Cross-facing, recessing and grooving, shown in gray, are handled by turret-mounted slide tools. The turret traverses forward against a dead stop and holds, locating the slide tools for length. Cross-feed is provided by a pusher rod on a back-facing attachment. Withdrawal of the rod combines with reverse-traverse of the turret for automatic tool relief.



Surfaces machined. Note severe interrupted and heavy forming cuts.



Chuck with bonnet support fixture. Piloted, multiple-tool holders and rugged slide tools on rigid Fastermatic produce fine finish with long tool life on severe interrupted and heavy forming cuts. Guarding has been removed to show tooling.

Octagon turret and 29½" swing allow 2F Fastermatic to replace hand-operated vertical turret lathes. Operator has ample time for other work during automatic cycle.

FAIRFIELD MANUFACTURING CO. BALANCES FOR QUALITY-PLUS

Gisholt 1SV1 Balancer provides mass-production economy on job-lots

Precision balancing of gears is one of the quality-plus features offered by Fairfield Mfg. Co., Lafayette, Indiana.

Mass-production economy is obtained on long- or short-run work using a standard Gisholt MASTERLINE 1SV1 Vertical Balancing Machine. The 1SV1 handles parts from two to 50 pounds, 17½" or less in diameter. It is ideal for balancing differential, bevel and spur gears, or similar parts that generally require only a single-plane, static balancing.

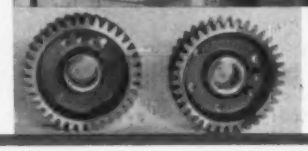
Tooling is relatively simple and inexpensive. Work is placed on adapters or expanding mandrel-type arbors that support and drive. A strobe lamp indicates the exact angle of unbalance on a numbered disc which rotates with the work. A direct-reading amount meter eliminates guesswork by showing the exact amount of unbalance in terms of drilling depth required for balancing.

Extra handling for correction is eliminated since drilling equipment is mounted on the balancer. This permits the operator to measure the amount of unbalance, locate the angle, correct by drilling, and rotate the part again for final inspection—all in one fast, combined operation. A simple scale assures accurate adjustment for various work diameters.

The gear shown here, an automotive supercharger component, is typical. Diameter, 4.068"; width, $1\frac{11}{32}$"; weight, 3.5 lb. Lots range from 200 to 500 pieces. Average setup time is only 15 minutes. Web thickness limits correction drilling to a ⅜"-diameter by 3/16"-deep hole, at a 2½" correction radius. Parts with large amounts of unbalance may require more than one hole. Despite this limitation, single-plane static unbalance is measured, corrected and inspected in an average of only 1.28 minutes, f.t.f.

Integral correction drilling equipment permits location and measurement of unbalance, plus correction and inspection, in one fast handling. It saves time and eliminates chance of error with one operator performing all operations.

Gisholt MASTERLINE 1SV1 Vertical Balancing Machine with integral correction drilling equipment. Drill column adjusts in or out for various work diameters. Simple adapters or mandrels are used to support and drive the parts.



3½-lb. automotive supercharger gear balanced in lots of 200 to 500 pieces. Setup time is only 15 minutes. Unbalance is measured, corrected and inspected in 1.28 minutes, f.t.f.

No. 7-859
739

The Gisholt Round Table represents the collective experience of specialists in the machining, surface-finishing and balancing of round and partly round parts. Your problems are welcomed here.

GISHOLT MACHINE COMPANY

Madison 10, Wisconsin

Printed in U.S.A.

Turret Lathes • Automatic Lathes • Balancers • Superfinishers • Threading Lathes • Packaging Machines • Masterglas Molded Plastic Products

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In carbide grinding the product-improving, cost-cutting "Touch of Gold," created by Norton leadership in diamond wheel development, began back in 1930. Today, man-made diamonds are adding something new to the "Touch of Gold." Their use as abrasives is steadily increasing, because of their improved performance and economy.

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WHY BUY METAL YOU DON'T USE?

Switch to Allegheny Ludlum Cast-to-Shape Tool Steel

FORGING

Stepped-out forging for fabricating spinning cone: 2300 lbs.—$2691 material cost plus cost of machining.

CAST-TO-SHAPE

Cast-to-shape spinning cone 1059 lbs. $860.97 Includes cost of the pattern.

$1,831 Saved by changing to Cast-to-Shape

Why pay for metal that ends up as chips on your floor? Here are two fine reasons for switching to Allegheny Ludlum cast-to-shape tool steels.

CAST-TO-SHAPE MEANS YOU BUY FEWER POUNDS OF METAL.

Because the tool you buy is closer to its finished shape, you obviously spend less money on original metal. In the above example, the savings in metal cost alone amount to $1,894.

CAST-TO-SHAPE MEANS LESS FINISH MACHINING.

A casting like that above has only ¼ to ⅜ inches of machine stock on all surfaces, requiring very little machining compared to solid chunks. Cast-to-shape tooling is especially economical when working with intricate shapes.

Allegheny Ludlum, a tool steel producer who makes cast-to-shape materials, casts them with the same precise quality control for which their tool steels is known. A full line of cast-to-shape tool steel grades is available. You'll find ones with high resistance to abrasion, compressive strengths of approximately 400,000 psi, easy machinability, hardening with almost no distortion, toughness, high red hardness, and the capacity to take a high polish.

Find out now how you can cut costs on your complex tools. Write for FC-4, a 28-page technical discussion of A-L's Forging and Casting Division with applications, pattern information, design tips, analyses, and heat treating instructions. Or call your nearest A-L tool steel warehouse or distributor.

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there's no need for "second guessers" in machinery replacement

Years ago it was common practice for a manufacturer who, by merely looking and guessing, would decide to replace this or that piece of machinery or equipment. He might guess right and he might guess wrong. If he guessed wrong as to timing, the company lost money. If he guessed right, they made money. But he had no method other than his personal judgment.

Today *you* can buy machinery with facts in front of you or by guess. But, if by guess, you'll be second guessed forever.

Today's methods are more factual and reliable.
If you would like to see what other companies have done to establish the most profitable time to replace machinery, get this newly enlarged book. Merely write to any one of the companies in our group . . . the Rockford Insert Group.

ugust, 1959.

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Keep gathering metal-working production ideas . . . be well informed when you replace machinery . . .

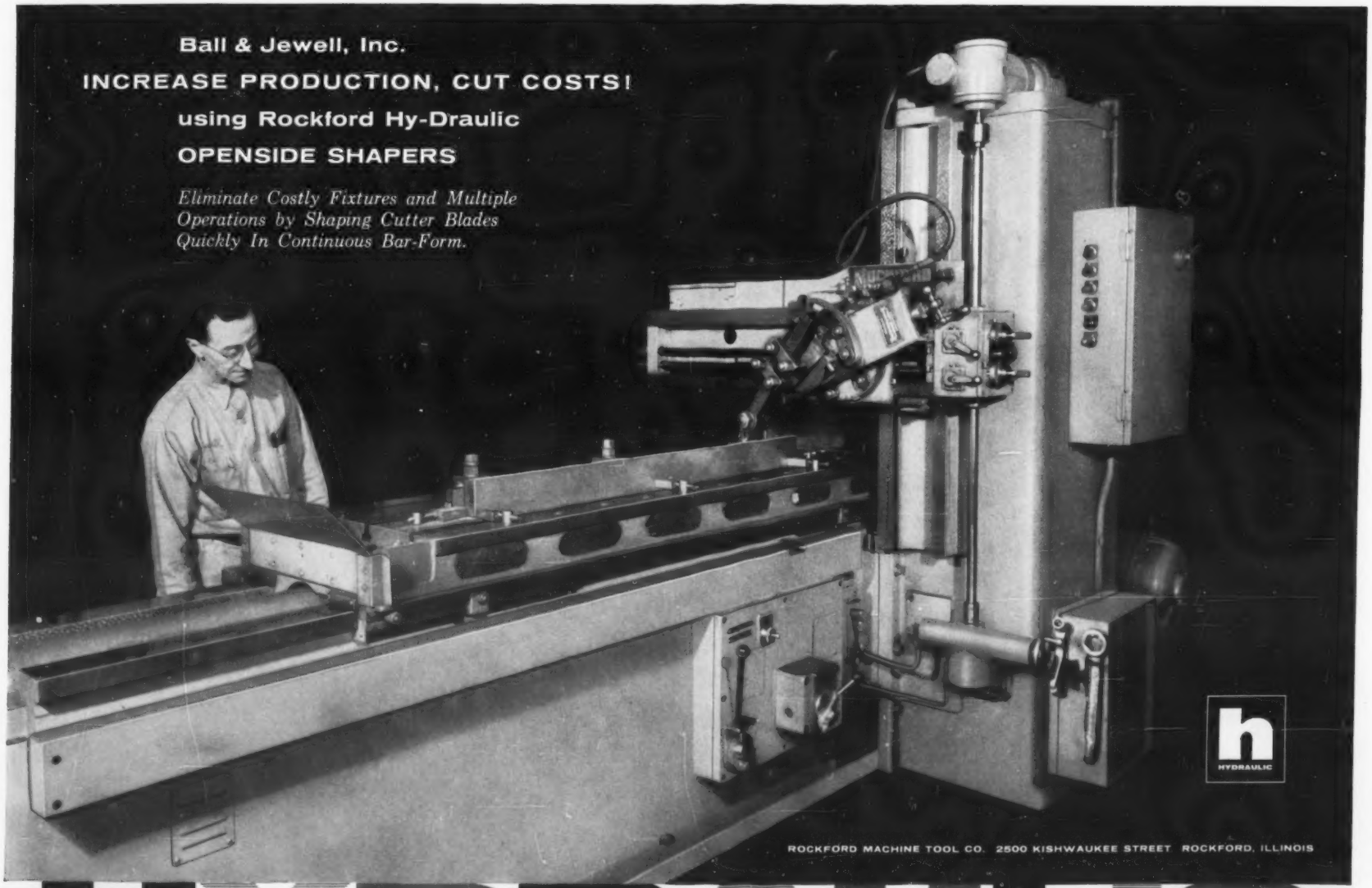
Ball & Jewell, Inc.

INCREASE PRODUCTION, CUT COSTS!

using Rockford Hy-Draulic

OPENSIDE SHAPERS

Eliminate Costly Fixtures and Multiple Operations by Shaping Cutter Blades Quickly In Continuous Bar-Form.



ROCKFORD MACHINE TOOL CO. 2500 KISHWAUKEE STREET ROCKFORD, ILLINOIS

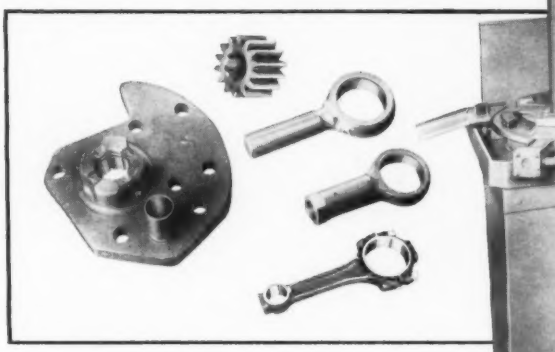
HY-DRAULIC

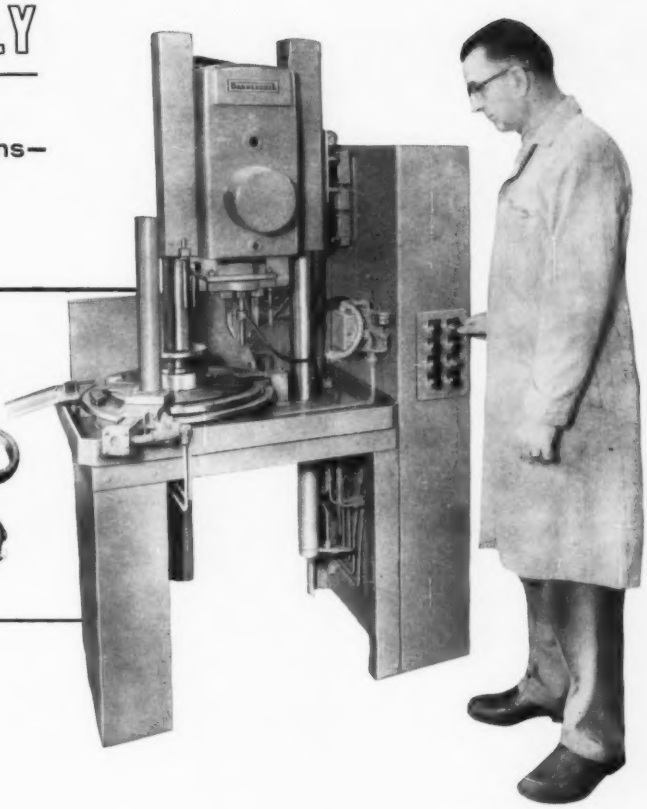
Machinery, August, 1959

CENTER OF MACHINE-TOOL EXCELLENCE ROCKFORD, ILLINOIS, U.S.A.

HONE SMALL PARTS
AUTOMATICALLY

High Production or Short Runs—
with bores up to 1-1/2″





This new No. 10 series of Single Spindle Vertical Honing Machines is designed with complete automation for handling small parts with bores up to 1½″. These machines are small and compact in size, highly accurate, and simple to operate. They are particularly efficient and economical for honing short production runs, as well as sustained high production work.

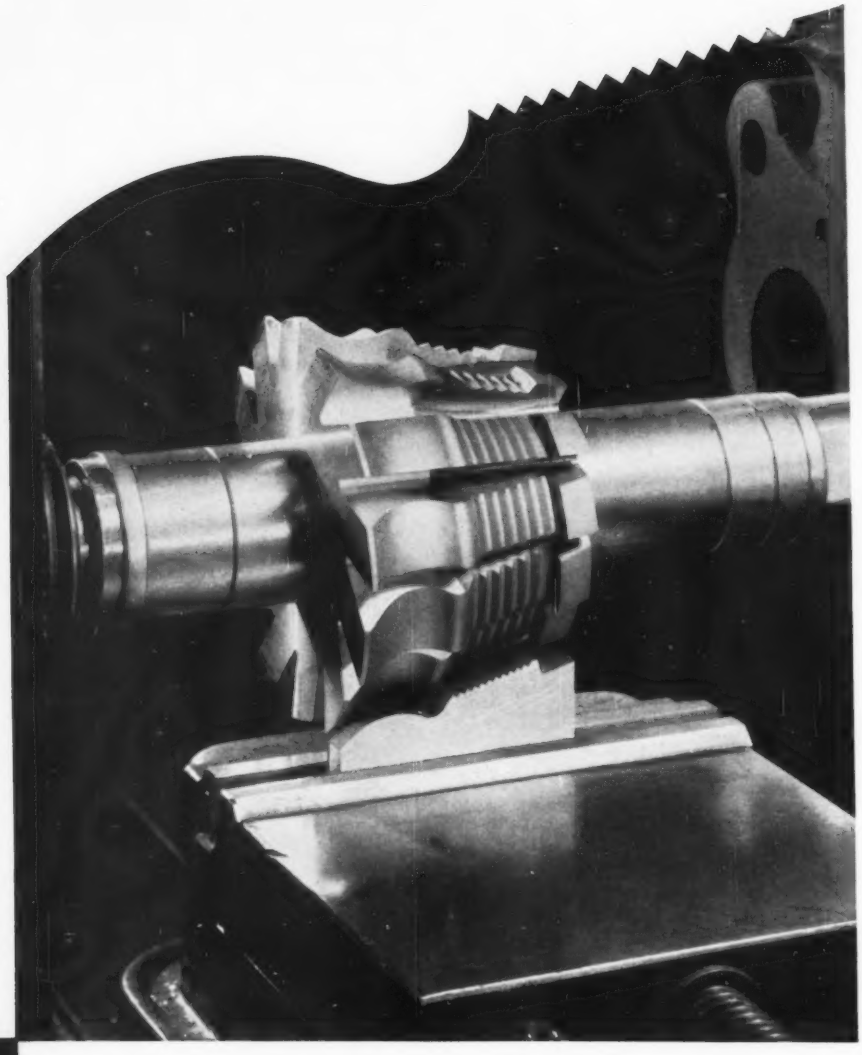
Design features include pneumatic hone expansion with automatic rapid expansion, feed and collapse of stones; automatic bore-to-bore sizing; magazine loading and automatic ejection. Automatic shut-down is also provided as honing stones become worn. Optionally, parts may also be automatically pre-gauged, honed, post-gauged, sorted and ejected.

Powered by an all mechanical system, these machines require very little maintenance. Rigidity and accuracy are assured through suspension of the reciprocating head between two columns.

For free estimates and complete information on application to your high-production small-part finishing operations, send blueprints to BarnesdriL engineers.

BARNES DRILL CO.
820 CHESTNUT STREET • ROCKFORD, ILLINOIS
DETROIT OFFICE: 13121 Puritan Avenue

CITY OF MACHINE-TOOL SPECIALISTS **ROCKFORD, ILLINOIS, U.S.A.**



Cutters with built-in Efficiency and Accuracy

This is an example of how efficiency and accuracy can be designed right into the cutting tool. The manufacturing and engineering capabilities of Barber-Colman Company can be added to your own in finding better solutions to milling problems.

The form shown at the left of the part is milled at the same time the multiple serrations are cut. Milling sharp points on the serrations is made possible by the alternate tooth design (see photo, above). The cutter is shown milling a sample which is later projected against an enlarged layout of the part to assure that the cutter will produce within specified tolerances. But, some of the most important quality features of this cutter are not visible to the naked eye.

Unground form . . .

Ability to combine complex tool geometry and accuracy in this cutter without form grinding reduces original cost. In addition to greater accuracy, you get longer tool life from a cutter that is metallurgically as well as geometrically well formed. Barber-Colman's individual processing in the most modern metallurgical lab and heat-treating department assures highest quality which can be tested by the number of high-quality parts manufactured for every dollar of cost.

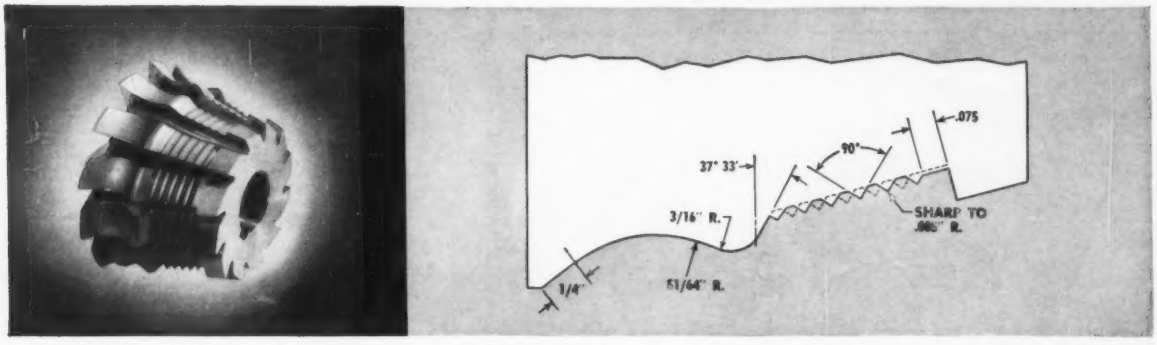
Sharpening economies . . .

Additional savings result from Barber-Colman's exclusive design and manufacturing techniques. For example,

CENTER OF MACHINE-TOOL EXCELLENCE **ROCKFORD, ILLINOIS, U.S.A.**

Mill Odd Shapes in One Operation

...with Barber-Colman Form-Relieved Cutters



the smooth finish on the tops and sides of the teeth eliminates rough edges — a common cause of breakdown on the flanks. Faces are index-sharpened, permitting the important economy of *automatic resharpening*. Your sharpening guide or an automatic sharpener will maintain original accuracy throughout the life of the cutter.

These economies reduce the most important elements of tool cost: the cost of scrap and rework, cost of sharpening, cost of downtime for tool changes, and cost of tool depreciation.

Five types of engineering...

You get more than a cutting tool when you buy "Barber-Colman." You get five types of specialized engineering that reduce your costs and upgrade your quality:

1. *Application engineering* — on-the-spot evaluation of milling problems by experienced tool designers.
2. *Design engineering* — highly specialized tool engineering, backed by electronic computer facilities for fast, accurate calculation of complex forms.
3. *Metallurgical engineering* — specially selected steels and heat treatment for your particular material and tool geometry.
4. *Manufacturing* — the most complete and advanced processes under one roof for producing exactly the right finish, highest accuracy, and *any* cutter style.
5. *Quality control* — optical master inspection, seven different control stations, and numerous separate inspections for individual cutters.

Whether you want to combine operations, change processes, or just get more out of your tooling dollar, you can have a Barber-Colman field engineer at your desk for consultation by just calling Rockford — TR 7-5741.

Barber-Colman Company

BARBER COLMAN ®

62 Loomis Street, Rockford, Illinois

FOR PRODUCTION MACHINE TOOLS IT'S **ROCKFORD, ILLINOIS, U.S.A.**

MATTISON
HIGH-POWERED PRECISION
GRINDING METHODS

Mattison surface grinders outproduce cutter-type machining on parts like these

Stop Lever Bracket

MILL	GRIND
58 min	44 min

Table Guide

MILL	GRIND
12 min	4½ min

Roll Housing

MILL	GRIND
16 min	11 min

Motor Base Plate

PLAIN	GRIND
82 min	57 min

Lock Bar

MILL & GRIND	GRIND
44 min	24 min

Feed Control Plate

MILL & GRIND	GRIND
35 min	20 min

Table Guide

MILL	GRIND
16 min	9 min

Roll Housing

MILL	GRIND
17 min	11 min

CONTINUOUS CUTTING ACTION SAVES MONEY

These jobs show how high-powered surface grinders speed stock removal (up to ¼ in. per side is economical) . . . with improvements in finish and accuracy. Real savings come from reduction or elimination of: scrap, downtime for tool changing and sharpening, setup time, fixture costs, and tool breakage. Ask for a test grind of your parts in our Methods Lab.

MATTISON MACHINE WORKS
Rockford, Illinois Phone WOodland 2-5521

MATTISON MACHINE WORKS ROCKFORD ILL. U.S.A.

HIGH-POWERED PRECISION SURFACE GRINDERS

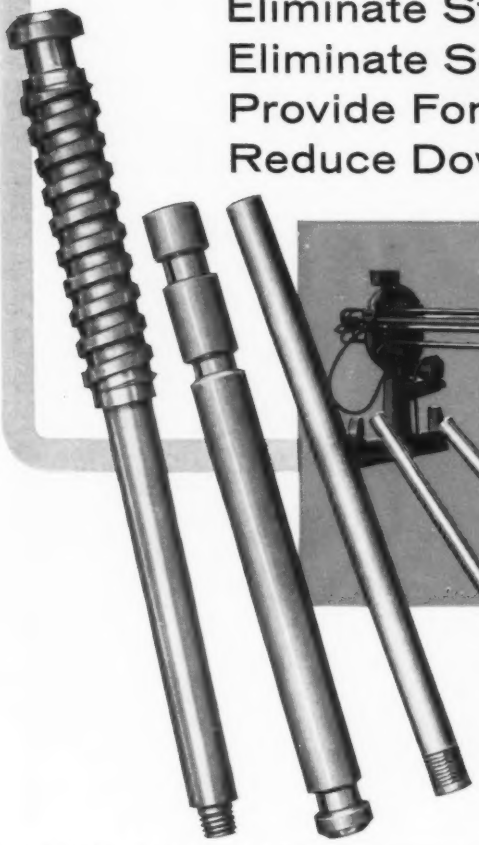
MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

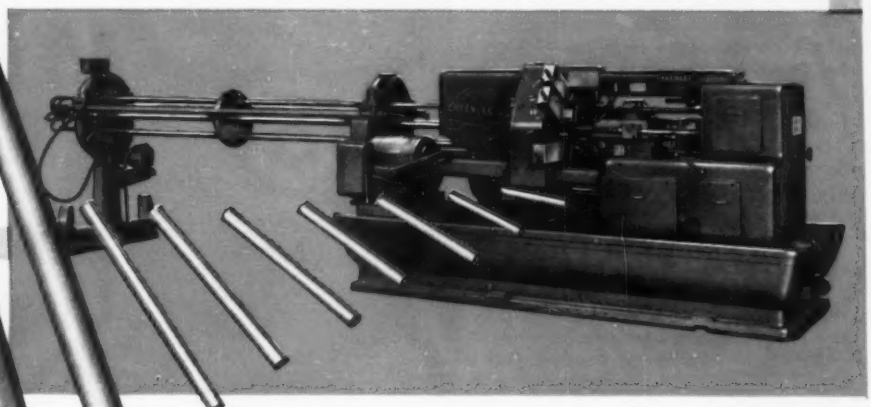
PRODUCTION MACHINERY

GREENLEE

AIR-FEED AUTOMATICS

Eliminate Stock Pushers...
Eliminate Scoring of Stock...
Provide For Extra Length Feed-Out...
Reduce Downtime During Set-Up





MULTIPLE FEED-OUT

Permits Greater Job Versatility and Added Profits

Greenlee Standard and Special Machine Tools

- Multiple-Spindle Drilling and Tapping Machines
- Transfer-Type Processing Machines
- Six and Four-Spindle Automatic Bar Machines
- Hydro-Borer Precision Boring Machines
- Die Casting Machines

Greenlee Air-Feed Automatics give you a competitive edge. The multiple feed-out arrangement offers a distinct profit advantage in machining many types of parts. Threads and oil grooves may be rolled on any portion of long shafts. Finish forming may be done on either end. See your Greenlee Distributor. He'll show you how Greenlee Air-Feed Automatics will pay off for you.

Write today for Catalog A-405 — first step on the way to more profitable production with Greenlee Automatic Bar Machines.

GREENLEE BROS. & CO.

1743 MASON AVE.
ROCKFORD, ILL.

FOR PRODUCTION MACHINE TOOLS IT'S **ROCKFORD, ILLINOIS, U.S.A.**

New Sundstrand Multiple Spindle Drilling and Boring Machine Offers Precision at Low Cost

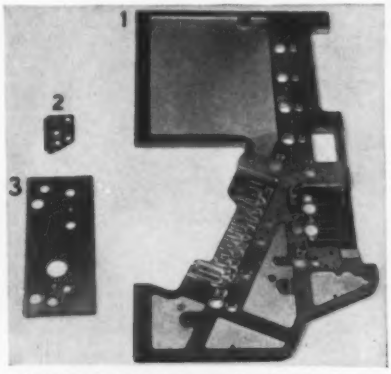
Sundstrand's new precision drilling, boring reaming and tapping machines, permit higher accuracies and lower costs in producing large numbers of holes on relatively complex parts. Unique design of the work heads eliminates all gearing, permitting close center distances, reducing cost of interchangeable work heads, and speeding change-overs.

Two models are available with either an 18 x 36-inch head or a 9 x 14-inch head. Machines are designed primarily for work with nonferrous metal parts.

Complete work heads can be changed in 15 to 20 minutes and additional flexibility for similar parts is offered by equipping heads with spindles that can be fitted quickly with a tool as required.

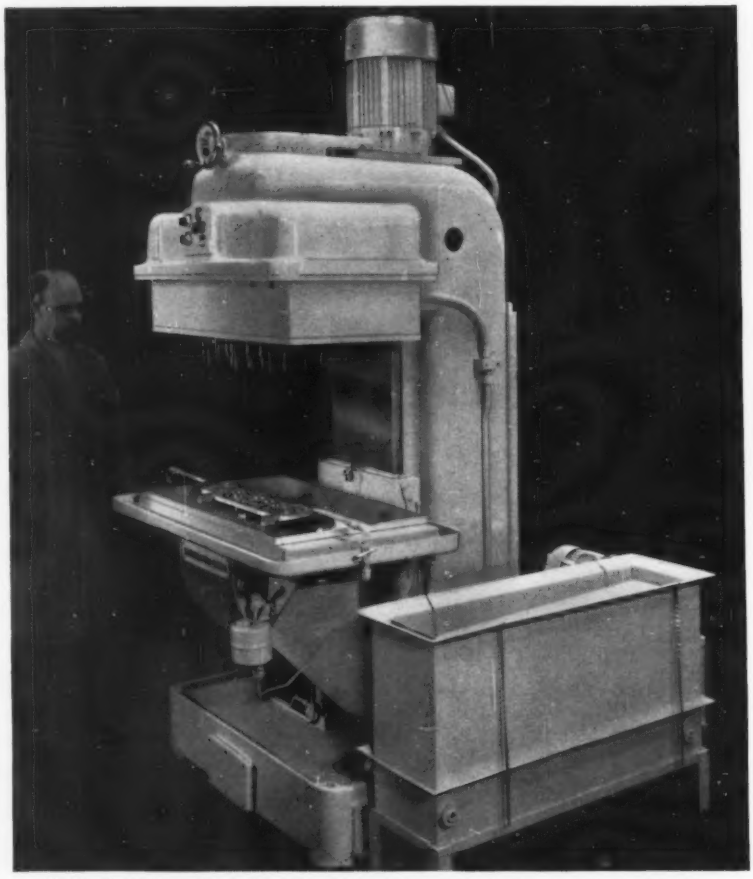
Unique design enables relatively low cost spindles to be used while maintaining the highest standards of accuracy. Furthermore, in the event of a change over in work being handled, approximately 75% of an obsolete head can be salvaged and applied to other jobs.

Highly skilled operators are not required to hold tolerances to .0002 inch for spatial relationship, shoulder depth and hole size — depending on size of part, shrinkage, expansion, material composition, tool maintenance, etc. Inspection requirements are greatly reduced because spatial accuracy is built into the head, fixtures, and machine itself.



Typical parts show wide range of work handled on new multiple spindle machine. Additional data is given in table on facing page.

Following initial inspection of tooling and a check of first parts produced, subsequent parts need only be checked for hole size and shoulder depth. Where spatial relationships are extremely critical occasional spot check is generally all that is required.



New Sundstrand multiple-spindle machine offers precision and simple change over, does not require highly skilled operator.

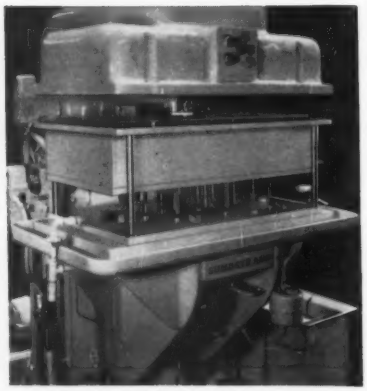


Table is lowered to take new work head in change over then is elevated until coupling on drive spindle mates with machine spindle. Dowels insure accurate alignment, four bolts hold head in place.

Even change-overs take no special operator skills since the head mates with the machine spindle, is located by dowels and is held in place by four bolts. The work-holding fixture is positioned quickly and simply in relation to the work head.

Surface speed at the largest hole being machined with a particular head determines all spindle speeds.

"Engineered Production" Service

SUNDSTRAND

MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

TYPICAL PERFORMANCE DATA

JOB NO. 1 ALUMINUM SIDE PLATE — 32¾" x 17" x ⅝". Seven heads are used to drill and chamfer 138 holes and to perform semifinish and finish boring, counterboring, and reaming operations on selected holes. Tolerances in most critical holes are +.0005, −.000 for size and ±.001 for location. Total machine time 4 minutes.

JOB NO. 2 ALUMINUM BEARING PLATE — 2.4" x 3.9". Stamped part has over 30 small holes and four large holes precision bored to +.0002, −.000 for size and ±.0001 for location. Total machine time 7 minutes.

JOB NO. 3 ALUMINUM SIDE PLATE — 12½" x 5" x ¾". Large holes previously rough drilled. All small holes are drilled, critical holes are semifinish bored, 2 holes are counterbored, and in final operation all critical holes are finish bored to +.0005, −.000 for size and ±.001 for location.

This does not impose any limitation on production as no other method will produce an equal number of holes at as low a unit cost and with the same high degree of accuracy.

Feed rates for drilling, rough and semi-finish boring in aluminum and magnesium are .005 to .008 inch per revolution. Finish boring in the same materials is at .0005 to .001 per revolution. Tapping heads can also be provided with the specific details of the application determined after a study of all the variables.

Multi-cycle 25 hp Lathe Announced

Sundstrand's new Model 14T-25 lathe handles three roughing and a finishing cut with a single template in a fully automatic cycle and insures exceptional accuracy of finished work because stylus and cutting tool are closely coupled to reduce deflection and related errors. Setup times are reduced and accuracy is increased by graduated scales provided for dog setting, template positioning, tailstock positioning, and cross facing slide location.

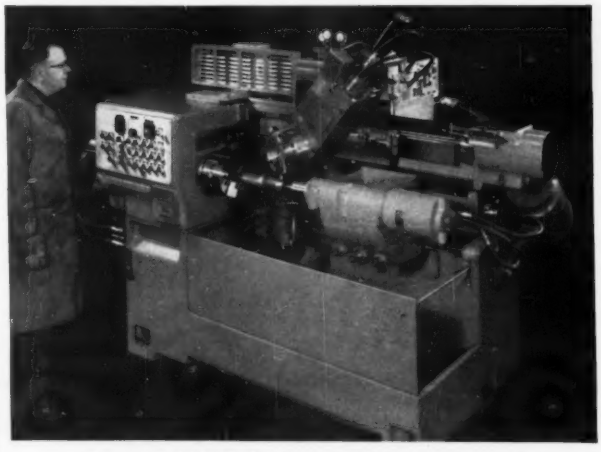
Dial indicators at the top of the tracing carriage permit depth of cut to be set accurately. At the completion of three roughing cuts, the tool turret indexes automatically to take a .020-inch finishing cut.

The Model 14T-25 is designed with the rigidity and spindle speeds required to use carbides for the roughing cuts and ceramic tooling on the finishing cut. Either two or four speed transmission-type heads are considered standard with eight speed heads available on special order.

Work area is readily accessible to simplify loading by operator or addition of automatic workhandling equipment. Sundstrand Model 14T-25 lathes are available with 24, 32, or 40 inches length between centers and offer a maximum turning diameter of 4½ inches. Facing slides with separate feed unit permitting operation at any time during machine cycle are available as optional extras.

Rough forging and finish turned shaft produced on Model 14T-25 lathe. Two setups handle complete part.

Stem pinion forging is turned in two setups with production rate determining whether one or two lathes handle the job.



Newly designed Model 14T-25 Sundstrand tracer lathe provides three roughing and one finishing cycle automatically.

SUNDSTRAND MACHINE TOOL

DIVISION OF SUNDSTRAND CORPORATION

BELVIDERE, ILLINOIS

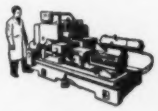
SUNDSTRAND

More facts about

SUNDSTRAND

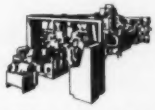
"Engineered Production"

Literature listed under various machine types has more details. Write Sundstrand for your copy today.

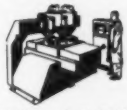


Automatic and Tracer Lathes
Bulletin A-106

Engineered Milling Production
Bulletin B-106



Examples of Transfer Machines—Bulletin C-106

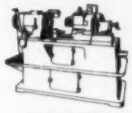


Multiple-spindle Drilling Machines—Bulletin D-106

Internal and Rotary Surface Grinders—Bulletin E-106

Broaching Tools
Bulletin F-106

Practical Broaching Methods
Bulletin F-106

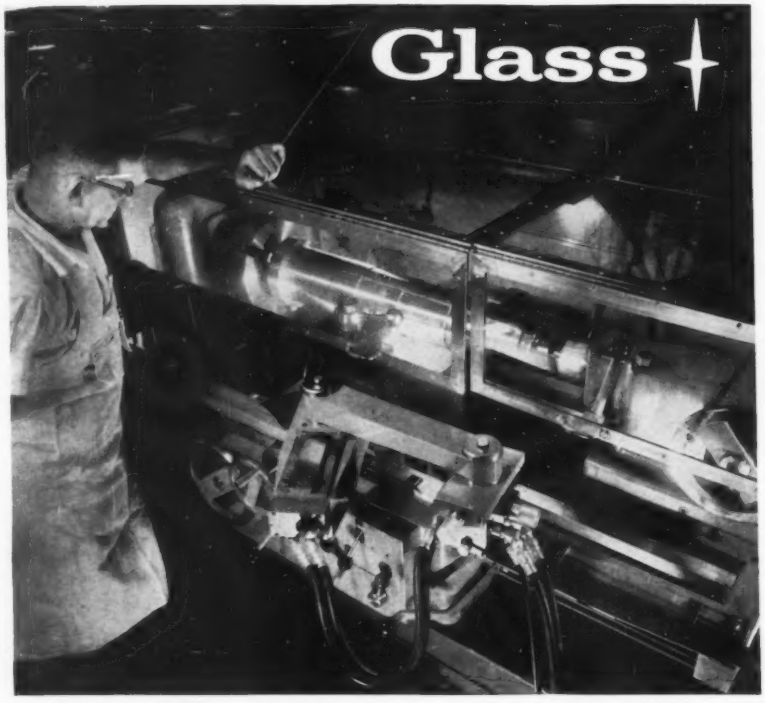


Thread Milling
Bulletin G-106

FOR PRODUCTION MACHINE TOOLS IT'S **ROCKFORD, ILLINOIS, U.S.A.**

Barber-Colman's new 36-speed tracer lathe shows startling results on short-run work. Total costs slashed at speeds which give 30-minute tool life.

Tracing Under Glass



Here is evidence that general-purpose lathes designed for carbide-ceramic speeds are one of the most profitable investments you can make.

The reason lies in the expendability of carbide inserts. Economical machine speeds with throwaways are far beyond those recommended in machinability tables. Speeds between 600 and 900 sfm, calculated to yield 30-minute tool life, reduce *total* cost per piece by as much as 80%.

An example is this 4140 steel forging — 32 in. long by 8 in. max. dia. It is step turned in 6 min. cutting time on a Barber-Colman 36-speed lathe. A hot stream of chips makes it necessary to shield the entire work area, a requirement for which the front-mounted tracer offers definite advantages. Thirteen different diameters are turned and two ends faced at 600 sfm, with .020-ipr feed and 1/4 in. depth of cut. Turning is done by a 1/2-in. triangular carbide insert. Floor-to-floor time is 19 minutes against the former time of 2.1 hours.

The objective in setting feeds and speeds was 30-min. tool life (per edge). But, even at 600 sfm, longer life is experienced due to the machine's unusual rigidity.

More examples . . .

Other jobs being turned at ultra-high speeds include long lead screws — 750 sfm at 1/16 in. depth of cut and .018 ipr feed. The machine turns out three times as much work as two lathes formerly used. In another step-turning operation, tests already prove a 52% gain over the previous time with tracer, and the maximum processed rate has not yet been established. These are savings on jobs averaging 6 to 50 pieces.

Versatile tooling . . .

This hydraulic tracer offers two advantages for increasing utilization of a lathe. *First*, it will duplicate consistently within .001 in. on diameter or length, and it will operate at 90° to the work axis.

Second, the attachment can be removed and replaced by the regular compound in just 20 minutes. This versatility permits economical use of the machine for turning, boring, roughing and finishing, tracing, and both internal and external threading.

Quality features . . .

The lathe itself gives you a new combination of design features that improve performance at high speeds:

(1) Unusual rigidity is provided by the 30 in. span of the front carriage way, scientific bed webbing, 400-lb tailstock, and precision-ground spindle supported at both ends and in the middle by three sets of tapered roller bearings.

(2) Headstock is a dense, Meehanite casting which responds best to vibrations encountered at high speeds.

(3) All headstock gears are hardened and ground.

(4) Automatic pickup on the carriage simplifies positioning of the two-speed tailstock through carriage feed or traverse.

Information . . .

Write today for our new 16-page catalog showing how this new Barber-Colman precision machine can pay for itself quickly as a replacement for an old lathe.

Barber-Colman Company

BARBER COLMAN

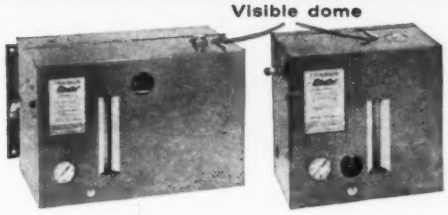
82 Loomis Street, Rockford, Illinois

MACHINES DESIGNED TO MEET YOUR NEEDS **ROCKFORD, ILLINOIS, U.S.A.**

TRABON®

CENTRALIZED LUBRICATING SYSTEMS

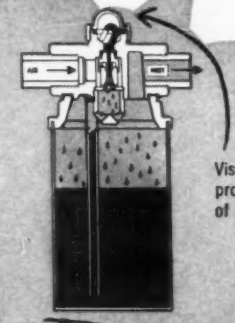
...packages with a plus!



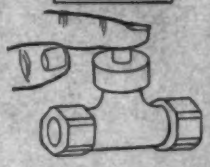
Meter-Mist units are available in 12 package sizes to fit every job.

Meter-Mist oil systems give you all these extras— at low cost

- Neat, compact lubricator units with all components housed in tamper-proof lock-cover
- Reservoir sizes up to 3 gallons—enough for 200 hours or more without refilling
- Misting-head capacities to handle up to 1000 bearing-inches without "manifolding"
- Complete visual indication of (1) oil feed, (2) air pressure and (3) reservoir level with cover closed and locked
- Pre-wired, with all wiring run to terminal strip
- Pre-piped, ready for air and outlet connections
- Remote mist indication at bearing tap
- Automatic controls and fool-proof warning signals



Visible oil feed dome provides a quick means of checking oil flow.



Finger tip pressure on pin of special flow indicator fittings located at remote bearings quickly checks mist condition at that spot.

Trabon Meter-Mist, the modern inexpensive lubricating method *for all types of bearings, slides and gears*, gives you the "extras" you want *in packaged form* when a centralized oil-fog system is indicated. Adopted by industry for machine tools, presses and even rolling mill lubrication, Meter-Mist systems transmit micron-sized particles of oil, formed at the misting-head, in the form of a dry mist to bearing areas via low pressure air. There, reclassifier fittings cause the mist to wet-out on the bearing or gear surface.

For more information about Meter-Mist and its 12 packaged models write for Meter-Mist Bulletin 659.

"Centralized" OIL AND GREASE SYSTEMS *"Meterflo"* CIRCULATING OIL SYSTEMS

Trabon Engineering Corporation 28807 Aurora Road • Solon, Ohio

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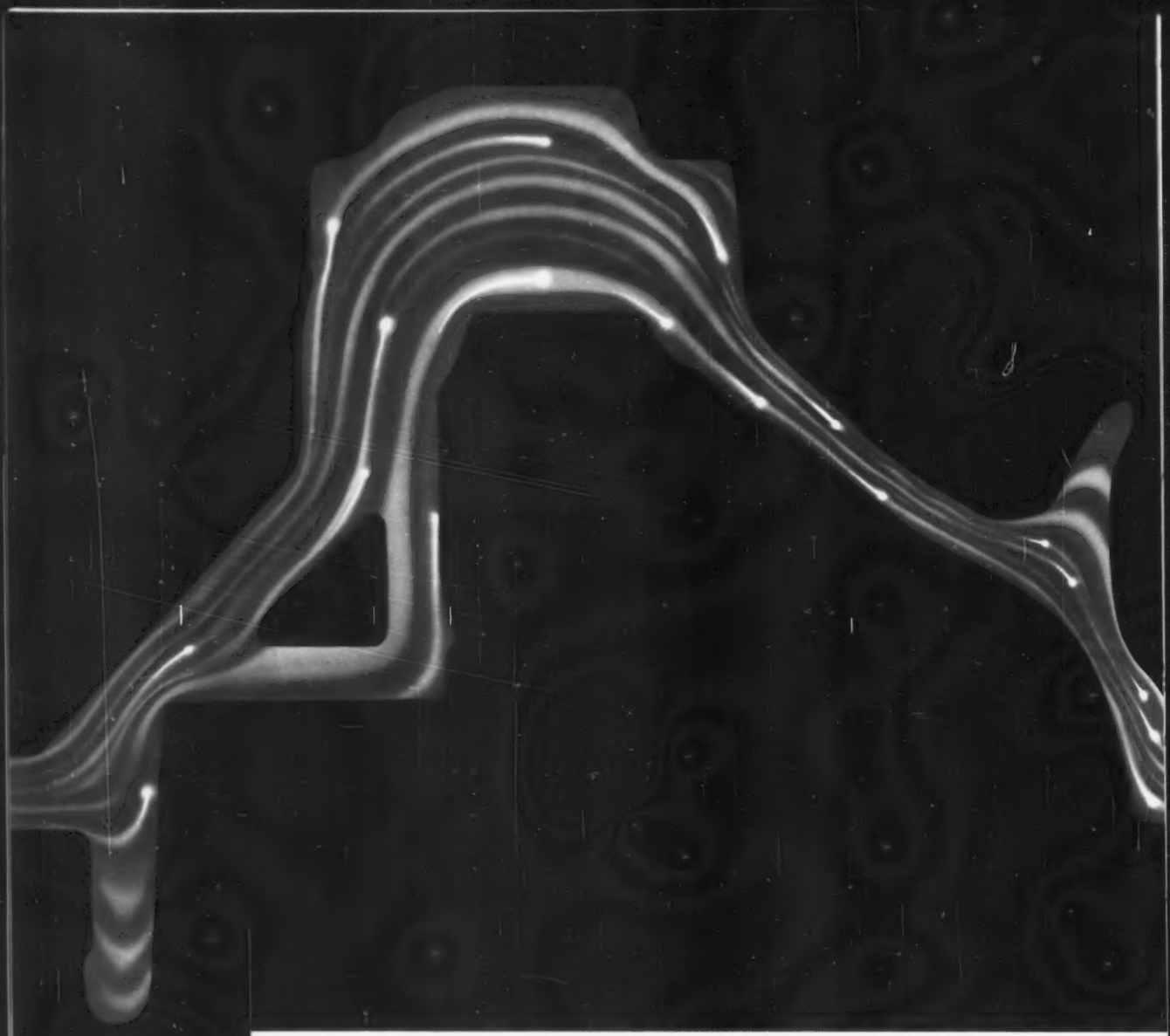


Fluid mapper pattern demonstrating liquid flow through a cross section of a Malleable differential carrier.

Versatility is Malleable

The ability to do most any job well is synonymous with Malleable iron castings. The variety of tasks they perform, from the commonplace to the spectacular, is legend. The strength and toughness . . . the freedom of design . . . the wide range of shapes and sizes . . . the excellent machinability . . . the economies achieved . . . all these advantages of Malleable combine to create an unexcelled reputation for versatility.

Whatever your needs, look first to Malleable.

For information or service, call on one of the progressive firms that identify themselves with this symbol—

MEMBER
MALLEABLE
CASTINGS COUNCIL

If you wish, you may inquire direct to the Malleable Castings Council, Union Commerce Building, Cleveland 14, Ohio, for information.

Versatility Is Key to Malleable's Increasing Use

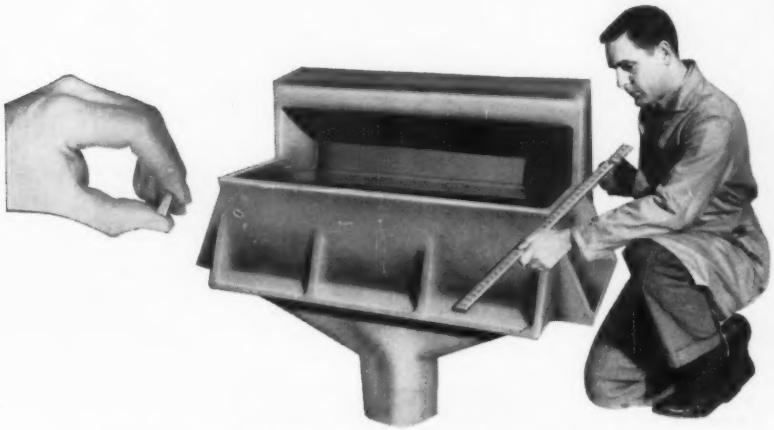
Recent metallurgical advances have made the Malleable irons a family of metals uniquely capable of meeting the most diverse design, production and performance requirements. Whether the vital consideration is high strength, toughness, ductility, hardness, machinability, high or low temperature performance, wear resistance, or economy and adaptability for complicated designs, Malleable castings have the versatility to meet exacting specifications.

For versatility of shape, the casting process is unexcelled. It permits direct production of the most complicated components. The metal is placed exactly where it is needed regardless of the intricacy of the design.

The capabilities of the metal to be cast are of even greater significance, for every application has a different set of requirements. Here, Malleable iron provides unique opportunities to obtain better parts at less cost.

Holes can be punched in Malleable, surfaces can be coined to meet rigid specifications. The pearlitic Malleables can be surface-hardened for even better wear resistance. These and other advantages make today's Malleable iron one of the most versatile engineering materials available.

Although Malleable iron's properties are flexible, depending on service requirements, certain relationships remain constant. Malleable provides more strength and toughness per dollar than any other metal. It is also the most machinable of all ferrous metals of similar properties.



Malleable castings can be produced in sizes ranging from the hammer handle wedge, shown here, weighing less than an ounce, to the 1,125 pound bridge scupper. Throughout this range is an endless variety of castings, best made of Malleable for highest quality at lowest cost.

Shapes and sizes of Malleable castings are virtually limitless. The combination of Malleable's good castability with modern production techniques regularly results in sections as thin as 1/16" and tolerances of ±.005" per inch in sections of 1", with excellent surface finishes.

Engineering Aids Available

While the design of Malleable castings is not complicated, it will pay you to consult a skilled Malleable engineer who can offer time and cost saving suggestions for the production of better parts. As another aid to basic Malleable casting design, a special folder — *Data Unit 104 — Design Versatility* — is available from any member of the Malleable Castings Council and from the Malleable Castings Council, Union Commerce Building, Cleveland 14, Ohio.

These companies are members of the

MALLEABLE CASTINGS COUNCIL

CONNECTICUT
Connecticut Mall. Castings Co., New Haven 6
Eastern Malleable Iron Co., Naugatuck
New Haven Malleable Iron Co., New Haven 4

DELAWARE
Eastern Malleable Iron Co., Wilmington 99

ILLINOIS
Central Fdry. Div., Gen. Motors, Danville
Chicago Malleable Castings Co., Chicago 43
Moline Malleable Iron Co., St. Charles
National Mall. and Steel Castings Co., Cicero 50
Peoria Malleable Castings Co., Peoria 1
Wagner Castings Company, Decatur

INDIANA
Link-Belt Company, Indianapolis 6
Muncie Malleable Foundry Co., Muncie
Terre Haute Mall. & Mfg. Corp., Terre Haute

MASSACHUSETTS
Belcher Malleable Iron Co., Easton

MICHIGAN
Albion Malleable Iron Co., Albion
Auto Specialties Mfg. Co., Saint Joseph
Cadillac Malleable Iron Co., Cadillac
Central Fdry. Div., Gen. Motors, Saginaw

MINNESOTA
Northern Malleable Iron Co., St. Paul 6

NEW HAMPSHIRE
Laconia Malleable Iron Co., Laconia

NEW JERSEY
Meeker Foundry Company, Newark 4

NEW YORK
Acme Steel & Mall. Iron Works, Buffalo 7
Frazer & Jones Company Division Eastern Malleable Iron Co., Solvay
Oriskany Malleable Iron Co., Inc., Oriskany
Westmoreland Mall. Iron Co., Westmoreland

OHIO
American Malleable Castings Co., Marion
Canton Malleable Iron Co., Canton 5
Central Fdry. Div., Gen. Motors, Defiance
Dayton Mall. Iron Co., Ironton Div., Ironton
Dayton Mall. Iron Co., Ohio Mall. Div., Columbus 16
Maumee Malleable Castings Co., Toledo 5
National Mall. and Steel Castings Co., Cleveland 6

PENNSYLVANIA
Buck Iron Company, Inc., Philadelphia 22
Erie Malleable Iron Co., Erie
Lancaster Malleable Castings Co., Lancaster
Lehigh Foundries Company, Easton
Meadville Malleable Iron Co., Meadville
Pennsylvania Malleable Iron Corp., Lancaster

TEXAS
Texas Foundries, Inc., Lufkin

WEST VIRGINIA
West Virginia Mall. Iron Co., Point Pleasant

WISCONSIN
Badger Malleable & Mfg. Co., S. Milwaukee
Belle City Malleable Iron Co., Racine
Chain Belt Company, Milwaukee 1
Federal Malleable Company, West Allis 14
Kirsh Foundry Inc., Beaver Dam
Lakeside Malleable Castings Co., Racine
Milwaukee Malleable & Grey Iron Works, Milwaukee 46

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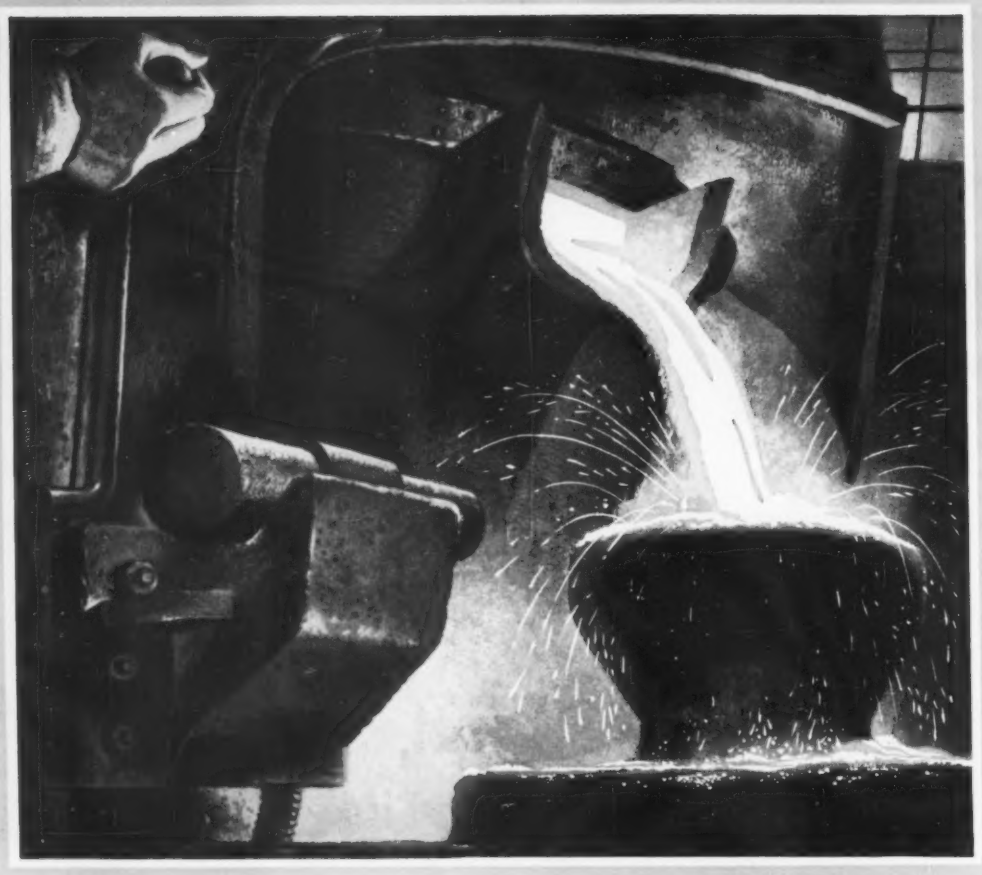


Melting furnace at Calumet & Hecla, Inc.—Wolverine Division, where Shell Irus Fluid 902 eliminates the danger of hydraulic line fires.

Ready... aim... NO FIRE!

Take 10 high-temperature alloy-melting furnaces, hydraulically operated—each pouring 1500 lbs. of molten metal every hour in close proximity to "live" hydraulic lines—and you can readily see why selection of hydraulic fluids is important to Calumet & Hecla's Wolverine Tube Division.

Now the operation is made more reliable by the use of Shell Irus Fluid 902, a water-in-oil emulsion type fluid. Irus® Fluid was C & H's choice, after carefully studying other commercial hydraulic fluids—for many reasons:

1. Irus Fluid will not support combustion.
2. Irus Fluid has excellent lubricating properties.
3. Irus Fluid has hydraulic efficiency and equipment compatibility.
4. Irus Fluid is economical, costing about one-third less than other fire-resistant fluids.
5. Irus Fluid's bright yellow color makes it easy to spot and trace leaks.

In plant after plant, operators find that these advantages assure maximum safety to both personnel and equipment.

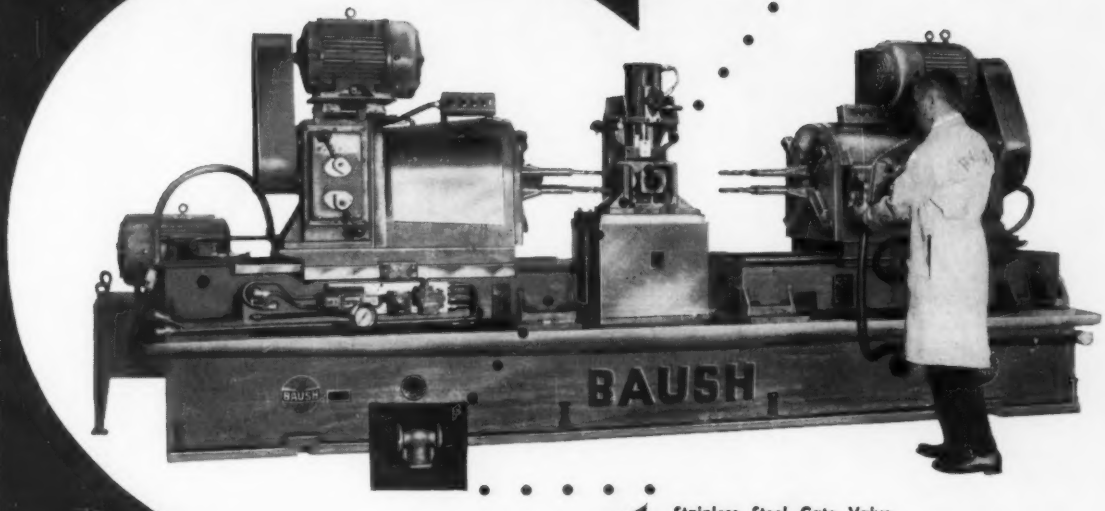
If you have a hydraulic line fire hazard, we suggest that you have the Shell Industrial Products Representative show you the many advantages in Irus Fluid 902; or write to Shell Oil Company, 50 W. 50th St., New York 20, N. Y., or 100 Bush St., San Francisco 6, Calif. In Canada: Shell Oil Company of Canada, Ltd., 505 University Ave., Toronto 2, Ontario.

SHELL IRUS FLUID 902

the low-cost, fire-resistant hydraulic fluid

SHELL

2-WAY HORIZONTAL DRILL HANDLES BOLT CIRCLE HOLES FROM 7/16" to 7/8" DIAM. in STAINLESS STEEL.



Stainless Steel Gate Valve with double bolt circles.

SPECIFICATIONS:

Whether it is a 36 station transfer, an 8 station rotary, or a unit such as this one illustrated — YOU CAN DEPEND ON BAUSH TO DESIGN AND BUILD THE BEST.

BAUSH
MACHINE TOOL CO.
SPRINGFIELD 7, MASSACHUSETTS

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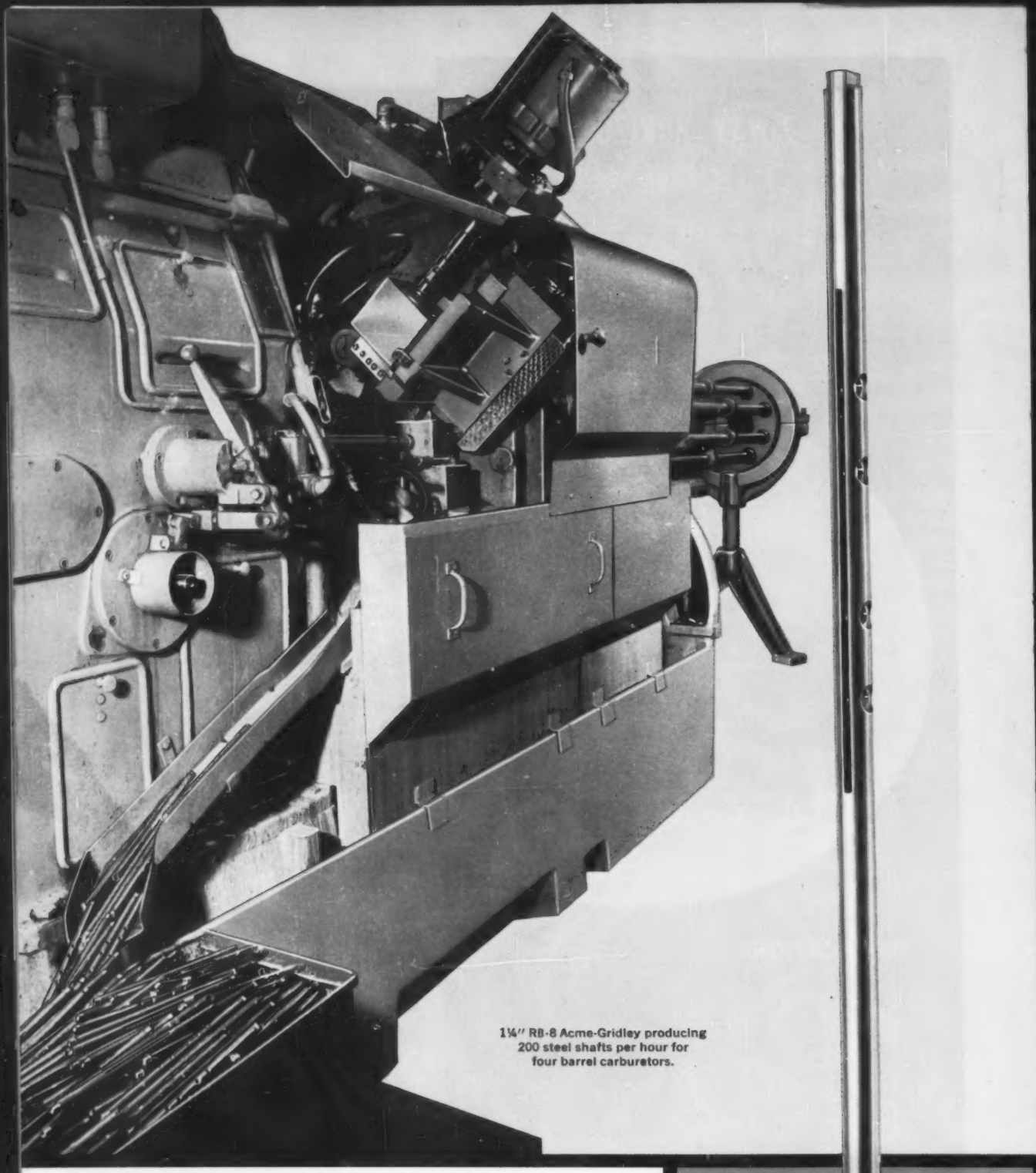


1¼" RB-8 Acme-Gridley producing 200 steel shafts per hour for four barrel carburetors.

NATIONAL ACME'S "ZONE OF RESPONSIBILITY"
INCLUDES ALL PHASES OF COST REDUCTION
Check YOURS . . . Then Check National Acme

Direct Costs: these include direct dollar savings as realized by Carter Carburetor . . . an "every day" job for Acme-Gridleys.

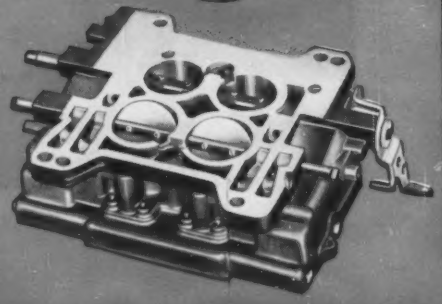
Indirect Costs: effecting important savings in maintenance, downtime, scrap reduction, tool costs, etc.

Product Redesign: teaming with your design group to take full advantage of Acme-Gridleys' cost reducing capabilities.

Direct Material Costs: our engineers provide important savings in this area by constantly matching machines and tools to modern metallurgical problems.

Make-or-Buy Reviews: in many cases our Contract Division can assume your production headaches and relieve you of immediate capital investment.

Spot Modernization: pioneering in modern tooling methods, and the flexibility of Acme-Gridleys can provide many "on-the-spot" savings.



Versatile Acme-Gridley produces

EIGHT DIFFERENT PARTS

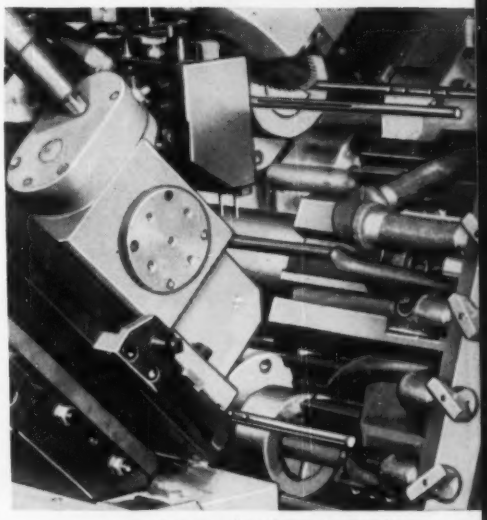
With Only Minor Changes in Tooling Setup

***For Carter Carburetor** division of ACF Industries, Inc.*

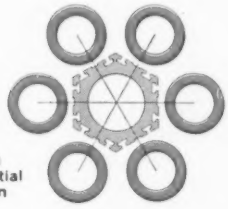
Here's machine tool versatility at its best . . . versatility that provides documented cost savings for Carter Carburetor year in and year out. Machine investment and cost-per-piece are greatly reduced. Illustrated is but one example.

The spindles of a standard 1¼" RB-8 spindle Acme-Gridley bar automatic were locked against rotation with a simple spindle locking device. Each spindle functioned as a work holder when the machine indexed from position to position. The inherent accuracy of Acme-Gridleys assured precise alignment of the work with the standard and special attachments . . . whether it's the first or last piece in the run. When spindle rotation is desired, the locking device is simply removed and replaced by the spindle drive gear.

Check the industry's most modern approach to tangible cost reduction. Call, write or wire today!



Close-up of tooling zone showing milling of slot in 4th position.

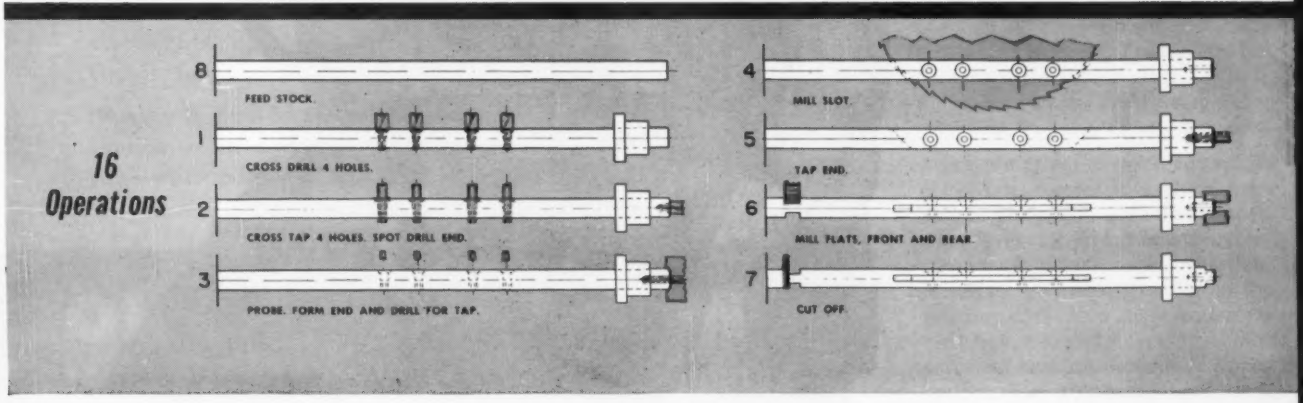


Pioneer in Circumferential Automation

National Acme

THE NATIONAL ACME COMPANY
179 E. 131st STREET
CLEVELAND 8, OHIO

Sales Offices: Newark 2, N.J.; Chicago 6, Ill.; Detroit 27, Mich.



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NEW TREPANNING LATHE

will handle high-alloy forgings up to 67 feet long

Reportedly the fastest as well as the largest trepanning lathe yet built in the United States, this huge machine will bore holes from 2" to 20" in diameter.

Faceplate speeds range up to 250 RPM. Boring-bar tailstock can be either stationary or rotating—with rotating speeds up to 400 RPM.

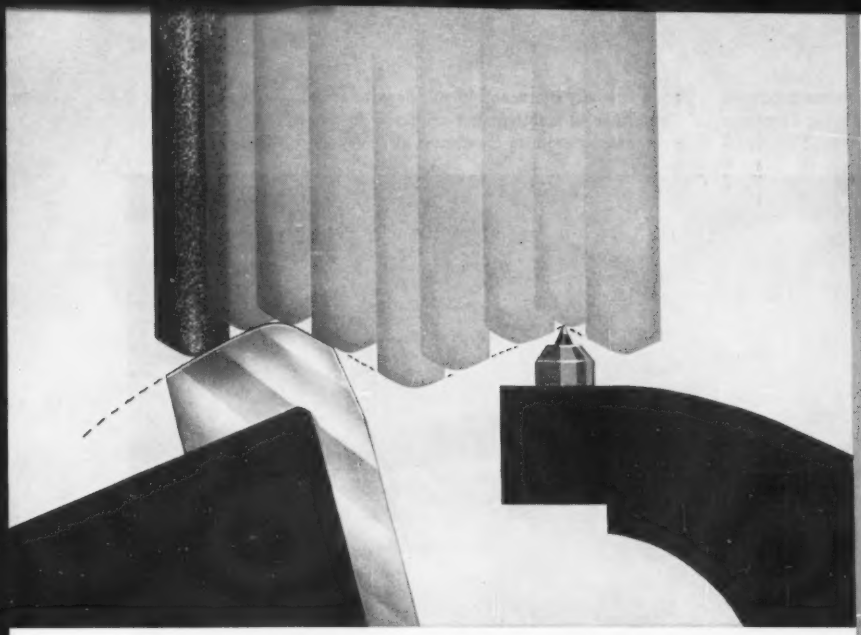
To eliminate damage to the mechanism from chips, the double rack-and-pinion feed is located under the ways. Rack-pinion design permits unlimited length of travel. Adjustable overload feed protection provides automatic bar retraction. Special roller steadyrests are supplied for convenient loading and high-speed operation.

We are prepared to engineer a trepanning lathe to meet your requirements. Send us your inquiry today.

FARREL-BIRMINGHAM COMPANY, INC.
CONSOLIDATED MACHINE TOOL DIVISION
565 Blossom Road, Rochester 10, New York
Plants: Ansonia and Derby, Conn., Buffalo and Rochester, N. Y.

CM-48

FARREL
BETTS
®



OLIVER'S FACE MILL GRINDER features automatic wheel dressing with every stroke

The drawing above shows the grinding wheel passing over a cutter tooth after being dressed and formed automatically by a fixed diamond. This happens with each stroke of the Oliver automatic face mill grinder. This exclusive Oliver of Adrian feature permits carbide grinding with a silicon carbide wheel. Automatic feed-down accurately compensates for each dressing thus providing a fixed grinding line which insures a minimum of run-out.

The machine automatically indexes the cutter and controls the tooth shape by a simple cam arrangement so that any practical roughing or finishing form can be obtained. Oliver's face mill grinder is hydraulically operated for smooth, fast (4 to 8 times faster per cutter), accurate and trouble-free performance.

In addition to the automatic machine, Oliver also produces a hand operated, heavy duty machine for all types of face mill grinding on coarse and fine pitch cutters from 4″ to 24″ in diameter. Still a third machine in this general family is the Oliver No. 2 Arc Radius Cutter Grinder for face mills and cutters requiring a radius on the corner.

Oliver will grind face mills on a "no charge" basis as a demonstration of the ability of the machines. We'd like to work with you—write today.

OLIVER of ADRIAN

1410 E. Maumee St. • Adrian, Michigan

DRILL GRINDERS AND THINNERS–TOOL AND CUTTER GRINDERS–AUTOMATIC AND MANUAL FACE MILL GRINDERS–TOOL BIT GRINDERS–CONTOUR SAWING AND FILING MACHINES.

A "TRIPLE CHECK" FOR FACE MILLS

To obtain peak performance in your face milling operations you must be certain to achieve (1) maximum cutter life, (2) lowest possible micro-inch reading on the surface being milled and (3) the most economical method of sharpening the cutter.

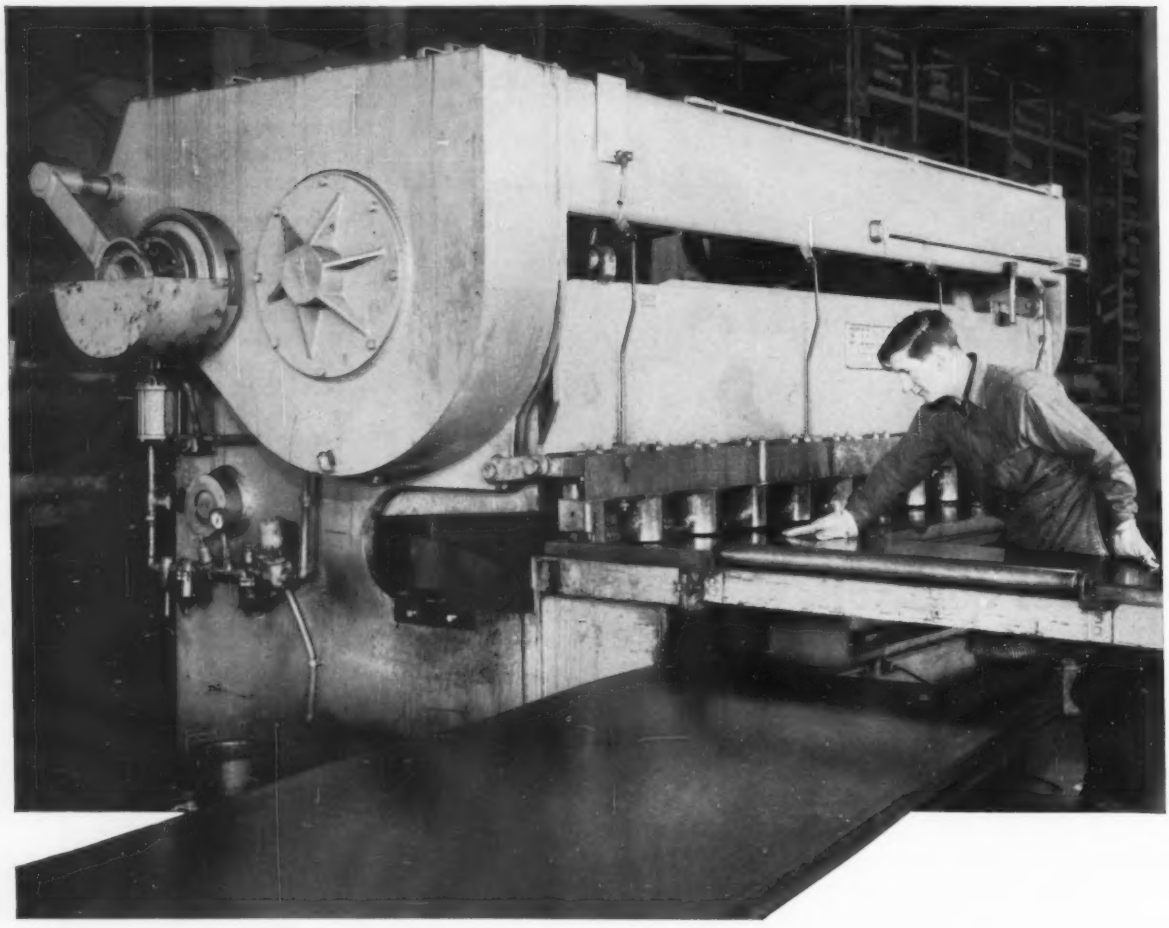
Check your performance to see if you are using all three of the following helpful hints:

1. Maximum cutter life requires the elimination of all sharp corner angles which are normally subject to early breakdown. The Oliver face mill grinder automatically incorporates a corner radius between the face and the lead angle thus correcting this situation. A test grind on your face mill will show a substantial increase in pieces milled per grind.
2. For the finest finish a radius should be used on the face rather than a straight line grind. The face radius

(40″ to 100″) eliminates the line contact which is largely responsible for the rougher milled surfaces. Standard cams include this feature automatically on the Oliver machine.

3. Minimum grinding costs require the use of fast, automatic machines capable of using semi-skilled operators. The Oliver face mill grinder provides for complete automatic operation, including the indexing as well as the grinding of the lead angle, corner radius, face, dish and the removal of the soft steel backing on carbide tipped cutters. The automatic up-feed of the cutter is an optional feature.

.002 inch clearance between knives produces sharp, straight, accurate edges in the 18 gauge metal cut on this Steelweld Shear. The clearance is easily increased to suit heavier metal. The shear operator is not confined to some average compromise clearance.



Cuts 1200 PIECES Per Hour

Farm Equipment Manufacturer Gets Sharp, Accurate Cuts Because of Steelweld's Exclusive Knife Clearance Adjustment

MASSEY-HARRIS-FERGUSON, Ltd., Toronto, well known throughout the world as a leading manufacturer of farm implements does much of the cutting required for the various steel parts with Steelweld Shears.

Massey-Harris-Ferguson obtains the best possible cuts because the knife clearance can be adjusted exactly to suit the thickness of metal being cut. It is not necessary to depend upon some compromise difficult-to-change knife setting with Steelweld Shears, as they are easily adjusted to the correct clearance in 10 seconds.

Write for free copy of Catalog No. 2011
Gives construction and engineering details

Illustrated is one of the many cutting jobs for which Steelwelds are used. 108-inch lengths of 18 gauge steel are cut into six 18-inch pieces at a rate of 1200 per hour. Knife clearance setting for this work is .002 inch. This shear has been in operation 24 hours a day, six days a week, for many years.

STEELWELD

PIVOTED BLADE **SHEARS**

STEELWELD DIVISION • THE CLEVELAND CRANE & ENGINEERING CO. • 5456 E. 282 ST. • WICKLIFFE, OHIO

What do you want in an inclinable?

AIR FRICTION CLUTCH? MECHANICAL CLUTCH?
FLYWHEEL OR GEARED PRESS?
SINGLE OR DOUBLE CRANK? AUTOMATIC FEEDS?
10 TON...200 TON?

Don't settle for "second-best" when the best may cost you less! Chances are whatever your needs in an inclinable, it's a Bliss standard—simply because Bliss makes more types and sizes of inclinable presses than any other builder. In fact, someone else's "special" may be a Bliss standard. Check it out for yourself before you buy—write for our most recent inclinable catalogs and data sheets. You'll see that size for size, no matter what you want in an inclinable, you get more press from Bliss ... large crankpins, long strokes, greater openings, bigger beds and many other extra values. A press that's backed by a century of press engineering ... by competent counsel ... by a **dependable** parts and service program. In short, you'd be wise to check Bliss—**first!**

E. W. BLISS COMPANY
Canton, Ohio

BLISS
SINCE 1857

Bliss is more than a name...
it's a guarantee!

PRESSES • ROLLING MILLS • ROLLS
DIE SETS • CAN MACHINERY • CONTRACT MANUFACTURING

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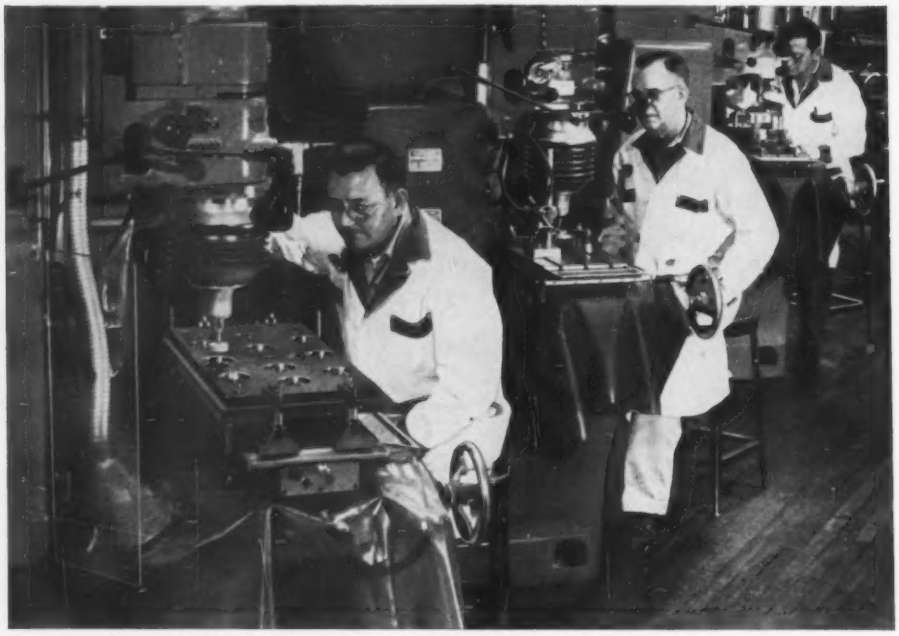
Val Koller tells why he continually adds more Moore Jig Borers and Jig Grinders to his team

This is another in a series featuring the views of owners of leading tool and die companies.

by **VAL KOLLER**
President
Koller Die & Tool Co.,
Milwaukee, Wisconsin
Manufacturer of Dies
and Metal Stampings—
Tools—Jigs—
Fixtures and Gages—
Special Machines



Moore equipment in Koller plant, with new #3 Jig Grinder in foreground.

"Since our foundation in 1919 it has been my personal objective to strive for perfection. Since that time perfection has evolved into a .000010" word for tool and die makers. Such precision is rapidly becoming common-place... particularly in electronics and guided missile fields of production. With the installation of Moore equipment in 1950, we have been able to compete successfully in a caliber of work that before was not possible.

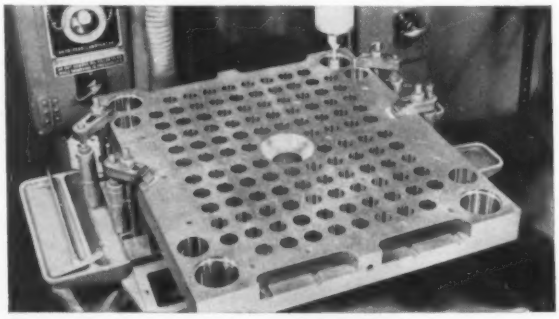
"Since that initial investment in a Moore Jig Grinder we have continually added Moore teammates to our toolroom. Today we operate more Moore equipment than any other top contract shop in the greater Milwaukee area.

"The tolerances and intricate contours now required make Moore Jig Borers and Jig Grinders a must in each toolroom. These machines operate at full capacity each workday with negative downtime due to mechanical failures. In fact, we have found that it costs real dollars and cents to operate *without* Moore equipment.

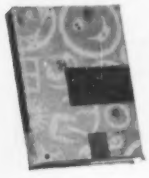
"This cost factor is just one of many reasons why we recently added another teammate to our toolroom ...the new Moore Model #3 Jig Grinder. This machine, with its tenth-splitting accuracy, hardened ways and wider range, enables us to service more customers better."

Write today for literature describing the unique features of #3 Moore Jig Borers and Jig Grinders or see our catalog in SWEET'S MACHINE TOOL FILE.

MOORE SPECIAL TOOL COMPANY, INC.
734 Union Avenue, Bridgeport, Connecticut



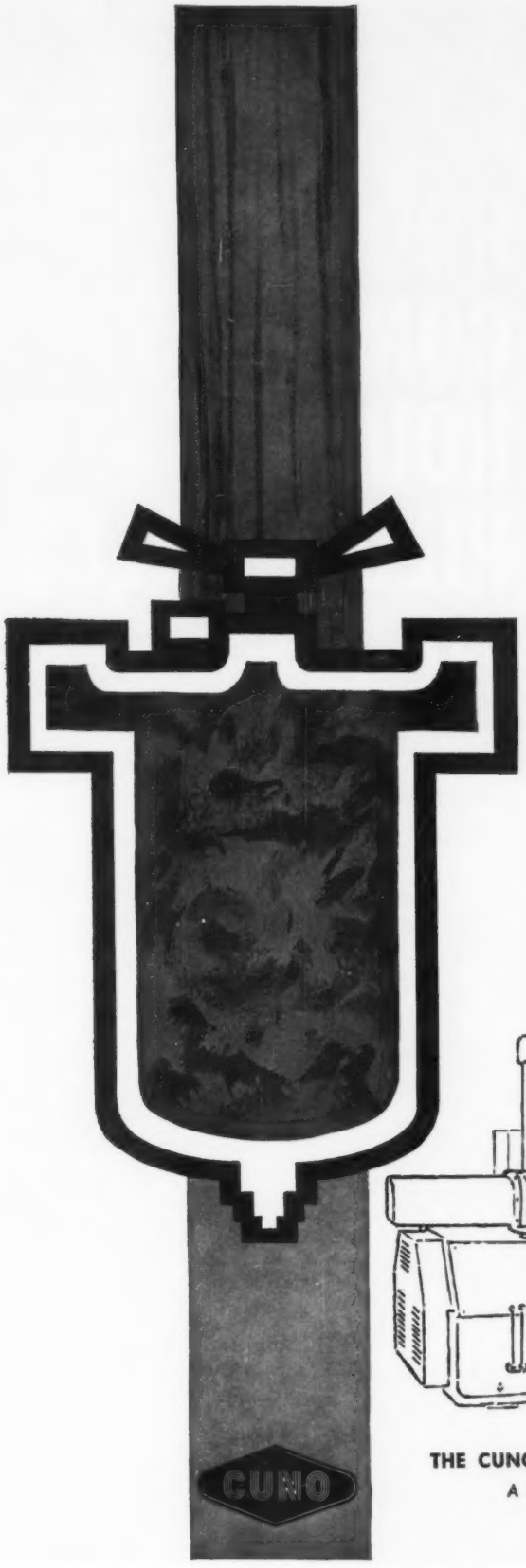
This 116 cavity mold plate was completely jig ground at Koller on a Moore Jig Grinder. Tolerances: hole location ± .0001", hole diameter ± .0001".



HOLES, CONTOURS AND SURFACES, tells how to produce tools and dies *the modern way.* 424 pages, 495 illustrations. $5 in U.S.A. $6 elsewhere.

ADD MOORE TOOLS TO YOUR TOOLROOM

JIG BORERS • JIG GRINDERS • PANTOGRAPH WHEEL DRESSERS • PRECISION ROTARY TABLES • HOLE LOCATION ACCESSORIES

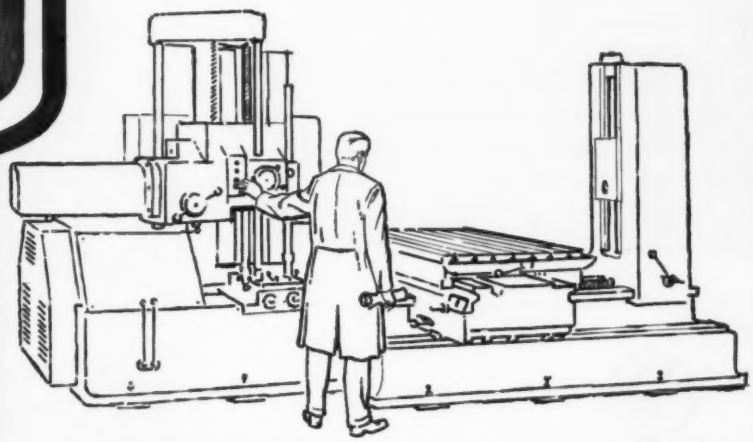


whatever the **machine tool application . . .** you can depend on **CUNO** engineered filtration

CUNO Filters are vital to the efficient operation of machine tool lubrication, hydraulic, and coolant systems. By removing damaging particles, they help reduce maintenance and replacement costs by protecting bearings, gears, valves, pumps, controls, etc. . . . help improve the quality of the product being manufactured.

Depending upon the specific application, CUNO offers you three basic filter types . . . CUNO Positive Self-Cleaning Edge-Type, CUNO Automatic Self-Cleaning Wire Wound Type, CUNO Disposable Depth Cartridge Filter . . . available in a variety of housings to meet *any* flow requirement.

Whenever *you* have a filtration problem—involving either a built-in application or a centralized system—write us. Our engineers will welcome the opportunity to demonstrate how you can *depend on* CUNO.



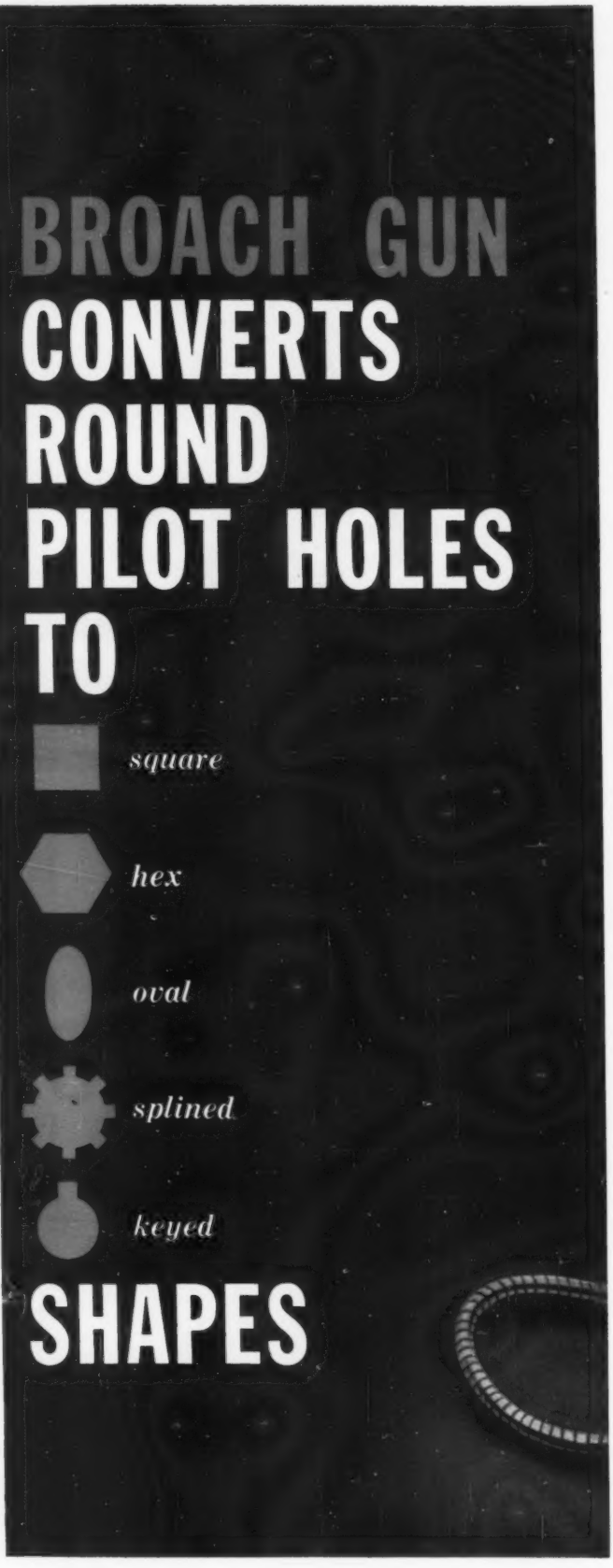
THE CUNO ENGINEERING CORP., Dept. 11, MERIDEN, CONN.

A Leader in Industrial Filtration for More Than 30 Years

In Canada: Peacock Bros., Ltd., P. O. Box 1040, Montreal 3, P.Q.

For more data, circle this page number on inquiry card

NEW CP PORTABLE BROACH GUN CONVERTS ROUND PILOT HOLES TO SHAPES



You take the tool to the work with the CP Portable Broach Gun . . . a completely new technique in broaching. Operation is fast and simple. Broach is inserted in pilot hole and with a squeeze of the trigger the hole is formed or finished in a single, swift operation. Set-up time is eliminated since no jigs, fixtures or templates are required in most applications. Drilled, punched or cast holes can be finished to round, square, hexagon, oval, or irregular shapes in any work area. Angle Broach Puller, for close quarters, is also available.

The broach pulls a clean hole every time, and leaves it "mirror" finished. Hole sizing accuracy can be ±.0002. Unskilled operators can consistently produce accurate holes with minimum training time.

CP Power Cell weighs only 58 pounds, operates on shop air lines, furnishes oil pressure up to 7,000 psi. Easily moved from job to job anywhere in the plant. Also powers hydraulic riveters, squeezers, punches.

Chicago Pneumatic

8 East 44th Street, New York 17, N. Y.

Pneumatic Tools • Air Compressors • Electric Tools • Diesel Engines
Rock Drills • Hydraulic Tools • Vacuum Pumps • Aviation Accessories

Portable, air-powered, hydraulic power cell weighs only 58 pounds.

Chicago Pneumatic Tool Co., 8 East 44th St., New York 17, N.Y.

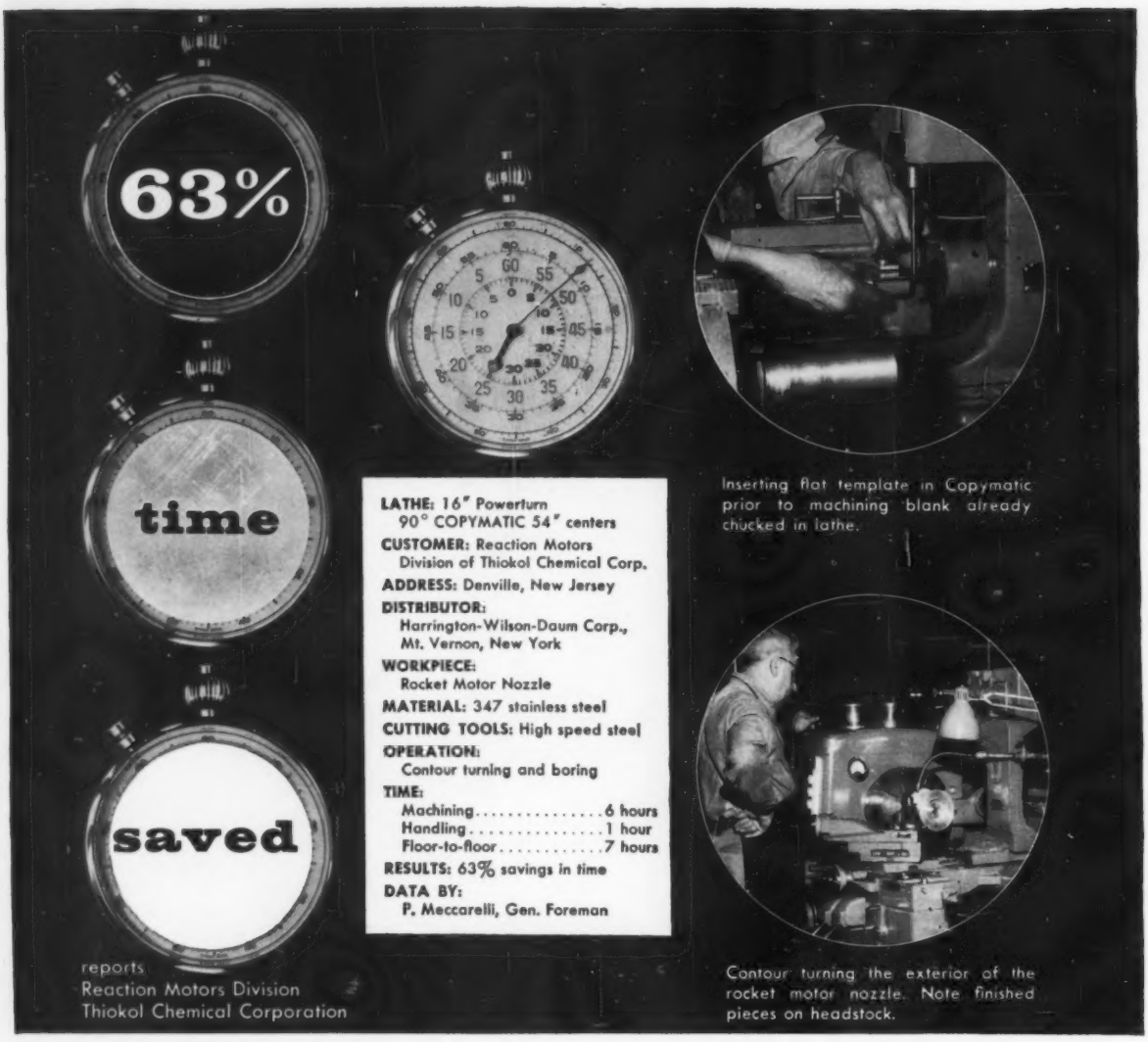
I'm interested in broaching holes. Please send me a copy of Bulletin 581-2. Dept. B-14

Name _____ Title _____

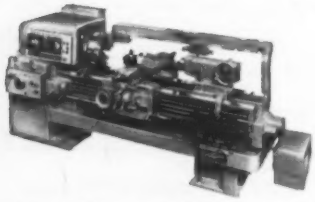
Company _____

Address _____

City _____ Zone _____ State _____



by this Lodge & Shipley Powerturn Copymatic Lathe



A pioneer in jet propulsion, Reaction Motors Division of Thiokol Chemical Corp., Denville, N. J., plays an important part in America's rocket defense and space exploration programs. In turn, and in turning, a Lodge & Shipley POWERTURN COPYMATIC plays an important part in rocket motor production.

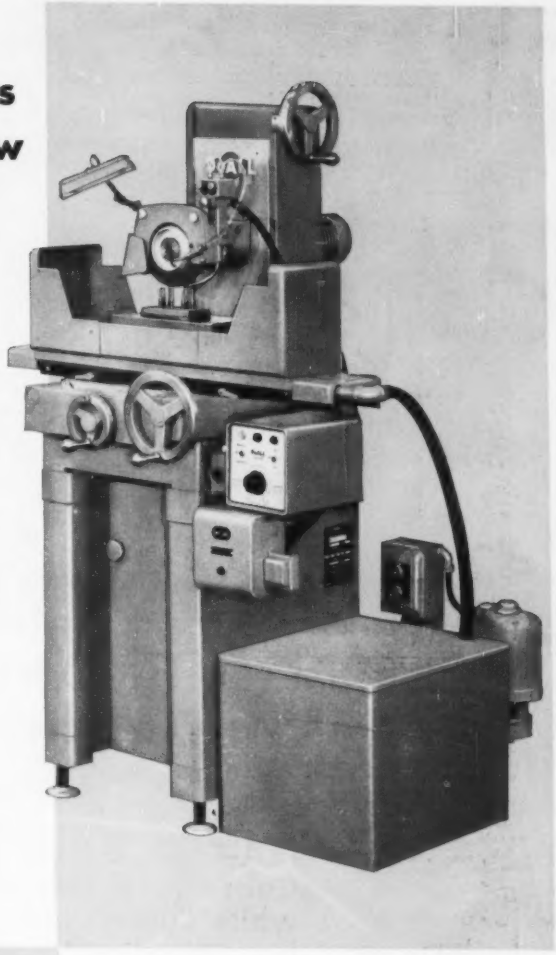
In contour turning and boring a typical reaction motor nozzle, the COPYMATIC cuts 12 hours from the previous time, completing the job in 6 hours machine time and one hour handling time.

Whether you're machining the new and tougher alloys or the old stand-by metals, you'll appreciate the strength, rigidity and extra power available in Lodge & Shipley Lathes. For special jobs or routine operations, the speed and accuracy of these world famous lathes offers much to virtually any lathe user.

Investigate the time and money-saving possibilities of Lodge & Shipley COPYMATIC Lathes with 45° or 90° tracer slides. Contact your Lodge & Shipley representative or write for literature:
The Lodge & Shipley Company, 3057 Colerain Ave., Cincinnati 25, Ohio

More than ever before, your LODGE-ical choice . . . **Lodge & Shipley**

No other manual grinder offers so many advantages as the new DoALL Model DH-612



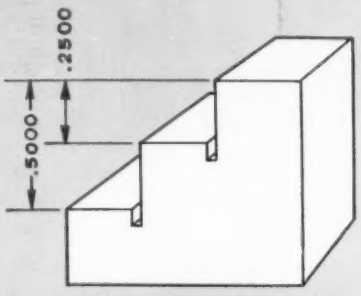
You've never seen a manual surface grinder with such accuracy, convenience and all-around flexibility as the DH-612. Compare it with all the rest—and see.

Accuracy—The DH-612 grinds to closer tolerances than others in its class. It is easy to grind accurately to handwheel calibrations—vertical feed to .0001″ and cross feed to .0002″. The 1 h.p. motorized or belt-driven, permanently lubricated, anti-friction bearing spindle provides steady, precise grinding action. There is no table climb because the saddle ways support the entire work area to the extreme ends of the table travel.

Convenience—Machine height can be adjusted for individual operators. The table drive handwheel can be easily moved for left- or right-hand operation and the wheel handle positioned to suit the operator. A one-shot lubricator oils all moving parts.

Flexibility—A complete line of attachments includes a downfeed handwheel extension to bring all controls within easy reach of a seated operator, also "Cool Grinding" coolant system, and hydraulic table operation. The grinders leave our factory prepared to accept these attachments at any time in the customer's plant.

ACCURACY PROVED



"Hardened tool steel step block"

The DH-612 grinds this step block directly from handwheel calibrations to "tenth" accuracy. This eliminates the grind-and-measure techniques commonly used. This impressive demonstration is one of many performance features that make the versatile DH-612 grinder outstanding.

The DoALL DH-612 Surface Grinder

Table travel: 7″ x 13″
Work height: 0″ to 12½″
Vertical-feed handwheel graduated in tenths
Saddle lock for form and plunge grinding
Full range of optional equipment:
- Zeroing slip rings for cross and downfeed
- Through-the-wheel "Cool Grinding" and flood coolant system
- Hydraulic table drive
- Magnetic chucks, permanent and electric types with DoALL SELECTRON® Rectifiers
- High-speed spindle attachment

SEE IT – TRY IT at your local DoALL STORE

See the new DH-612 grinder. Try its many advanced features. Call your local DoALL Sales-Service Store or write:

GR-28

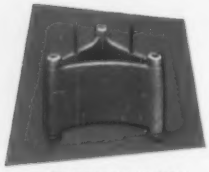
THIS IS A TYPICAL DoALL STORE

The DoALL Company, Des Plaines, Illinois

For more data, circle this page number on inquiry card

7 PLA-CHEK GAGES stand guard over Ford precision and accuracy in this Layout and Inspection room at Ford Motor Company's Dearborn engine plant in Dearborn, Michigan
1
2
3
4
5
6
7

7 of 200 Reasons Why Inspections are *Faster at Fords!*



PRECISION RISERS

Built with the same precision as the gages themselves. PLA-CHEK Gage Risers may be used to extend the usefulness of every PLA-CHEK Gage from the smallest to the largest size. Available in 6″ height for 6″, 12″, 18″ PLA-CHEKS . . . 12″ height for 24″, 36″, 48″ models.

MICROMETER THIMBLE

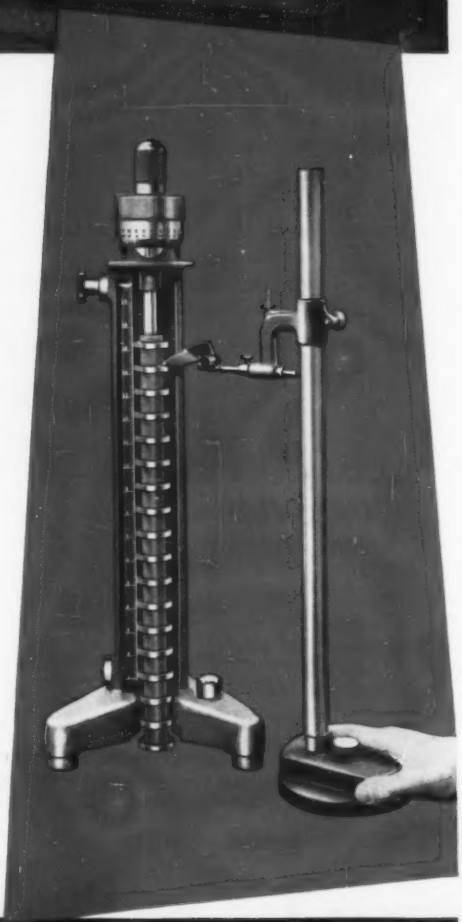
Is graduated to .0001″ and provides dimensions between 1″ steps on measuring bar. Measuring bar of the 18″ model (as illustrated) and larger models, can be adjusted to enable the user to take readings up or down relative to a center line or other reference line on the work.

PLA-CHEK GAGES Guard Ford Precision while Cutting Inspections from Minutes to Seconds

Precision is a law at Ford Motor Company. And speed is essential to the maintaining of high volume production. That's why you'll find more than 200 PLA-CHEK Gages at work in various Ford plants speeding inspections while guarding Ford precision and quality.

PLA-CHEK GAGES, available in a full range of sizes to meet every surface plate inspection and layout requirement, can be set 5 to 20 times faster than other methods of comparable accuracy. They are guaranteed accurate to .00005″ throughout the entire range of the 6″, 12″ and 18″ sizes and in the 24″, 36″ and 48″ sizes to .0001″ in any 24″ length or .0002″ over their entire range.

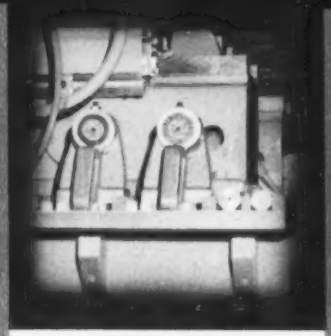
In August, 1946 Ford Motor Company purchased its first PLA-CHEK Gage. Today there are 200 at work in Ford inspection rooms and at Ford machines. Such confidence on the part of Ford Engineers must be deserved. Let us tell you how you, too, can speed inspections, maintain extreme accuracy and save money with PLA-CHEK Gages. Write for complete, detailed literature.



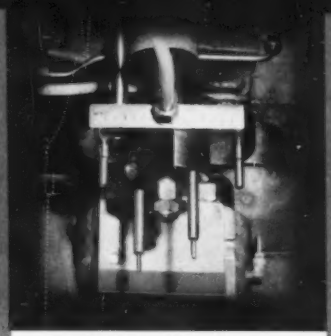
Cadillac GAGE COMPANY

P.O. BOX 3806 • DETROIT 5, MICHIGAN

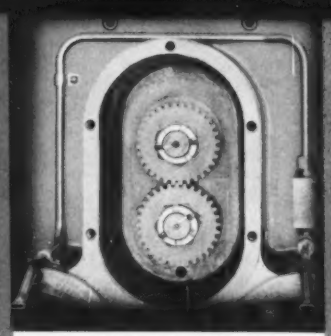
CLEANLINESS: Fixtures and parts are washed on return conveyor.



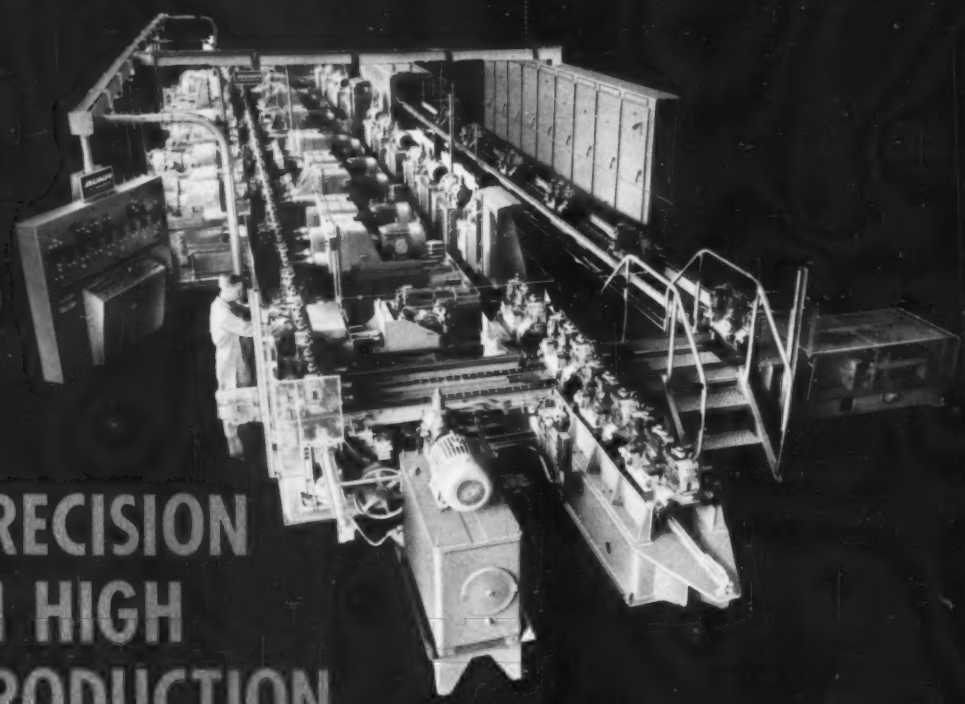
SETUP & TOOL CHECK gages are provided at all key stations.



PROBING stations at key points locate and signal any tool breakage.



CHANGE GEARS in heads for changing cutting speeds if desired.



PRECISION IN HIGH PRODUCTION

Tolerances as close as a few tenths can be maintained on Buhr ECONOMATICS when required

PART—hydr
CYCLE TIME—
OPERATIONS-
STATIONS, to
OPERATIONS-
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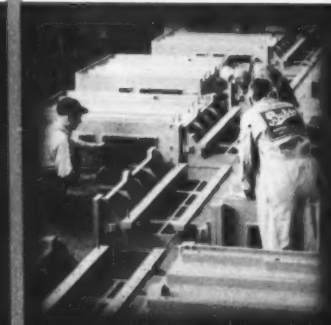
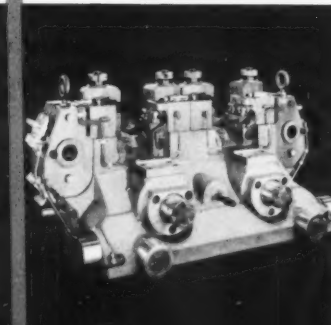
SPOT GAGING of parts in process without stopping machine.

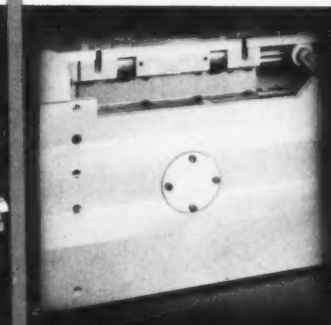
BUHR "BUILDING-BLOCK" construction does not sacrifice rigidity.

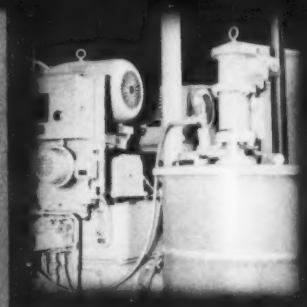


PRECISION BUILT FIXTURES give 100% parts interchangeability.

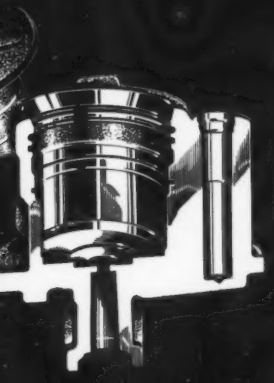


CONVERTIBILITY is further aided by providing 10 future potential work-stations.



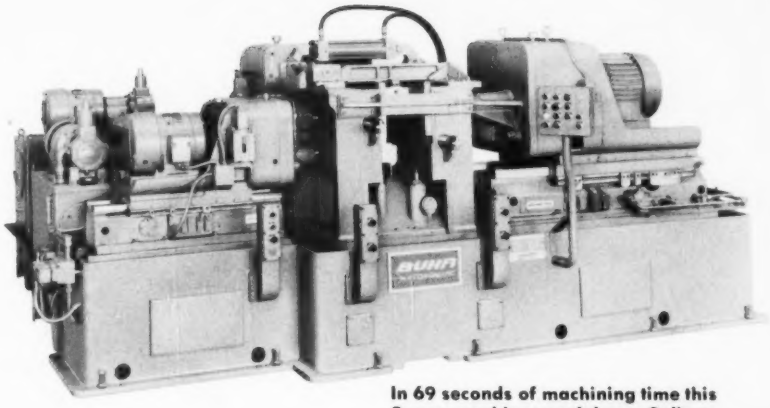


AUTOMATIC LUBRICATION
of entire machine except motors.



hydraulic pump housing
IME—24 secs. for 2 parts
IONS—115
NS, total—26 stations
IONS—drilling, tapping, aming, spot-facing, boring, rm-grooving, feed-out facing, obing and gaging
NCES—as low in some cases a few tenths of a thousandth ith excellent surface finish

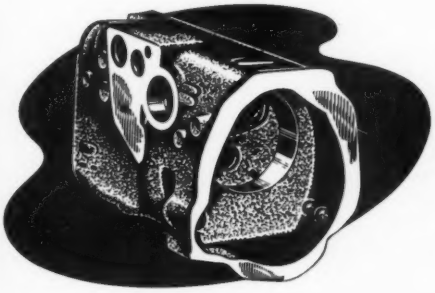
GOOD ACCESS for tools etc., provided by ample room between stations.



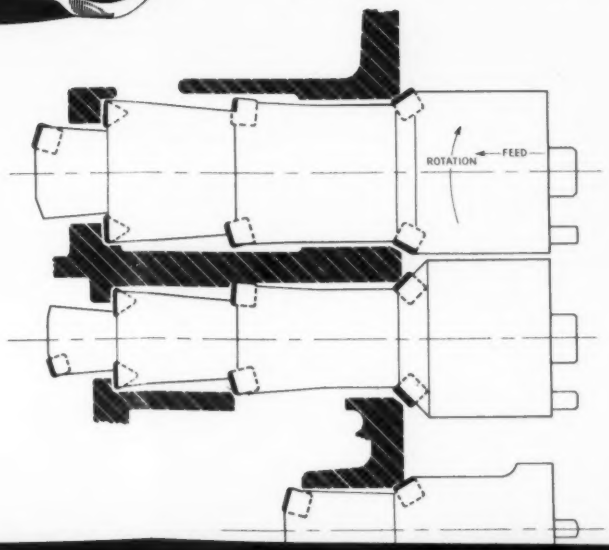
In 69 seconds of machining time this 3-way machine rough bores 9 diameters, semi-finishes 4 bores, machines 7 chamfers and 3 faces.

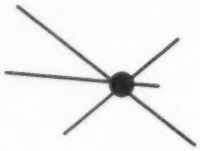
ECONOMATICS SAVE MONEY IN LOW PRODUCTION, TOO

By combining numerous operations through multi-diameter boring tools, using throwaway inserts, only 4 simple 2-way and 3-way Buhr Economatics produce all bores in the transmission housing for one of the major tractor producers.



Diagrammatic sketch below shows the three spindles of the right-hand head of the machine illustrated above. Throw-away inserts are combined in specially designed tools to rough bore, chamfer and face various openings. Related dimensions can be held closely because they are formed by the same tool. Tool grinding is unnecessary and set-up time is minimized.





BUHR

MACHINE TOOL COMPANY specializes in the design and construction of practical versatile multi-operation machine tools.

Basic features stressed in all Buhr machine tools include:

QUALITY—rugged design and manufacturing accuracy are combined to provide long trouble-free operation.

CONVERTIBILITY—Buhr uses standardized "building-block" parts wherever possible in its machines, fixtures, etc. All such parts are held to interchangeability tolerances.

PRODUCTIVITY—dependability is designed and built into Buhr machines to insure maximum productivity per man-hour consistent with production requirements.

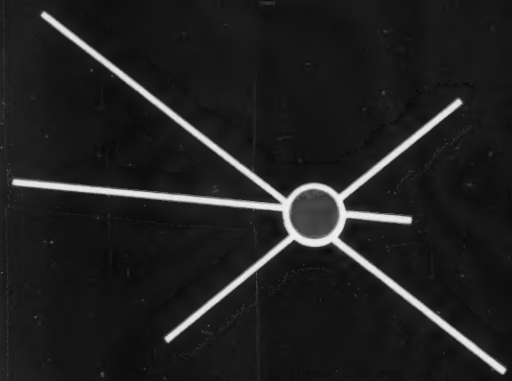
LOW DOWN TIME—every effort is made to minimize downtime by careful attention to future maintenance requirements, etc.

VERSATILITY—Buhr machines have a well-earned reputation in industry for their versatility. Many can produce a variety of parts with minimum changeover time.

Buhr welcomes the opportunity of discussing your machining requirements. Give us a call or drop us a line.

BUHR
MACHINE TOOL COMPANY

ANN ARBOR, MICHIGAN



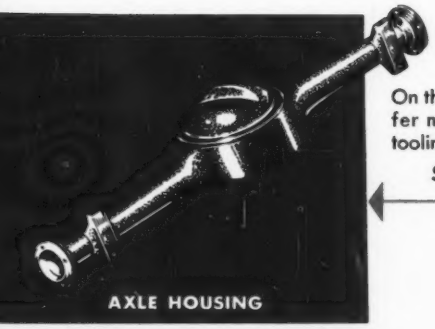
BUHR

the symbol of quality in multiple operation high and low production equipment

two more examples

Typical jobs on various *BUHR* Economatics

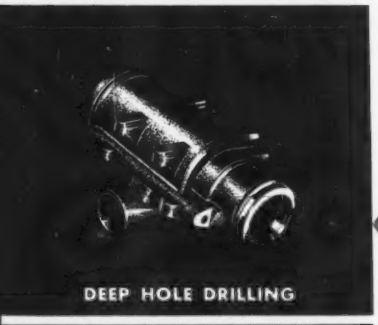
Any random selection is naturally incomplete. If you don't see a part that looks like yours, send us a part print and we will be happy to tell you what Buhr Economatics are doing to cut costs on your type of part.



AXLE HOUSING

On this part, a short Buhr Economatic transfer machine has eliminated an annual retooling cost averaging $40,000 per year.

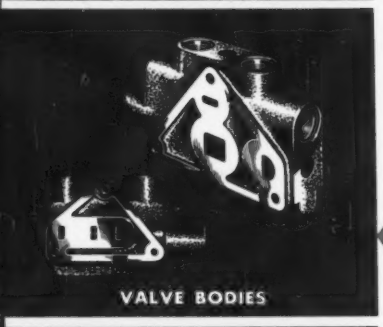
Short Transfer Machine #C-5188



DEEP HOLE DRILLING

On this conventional Economatic, a ¼" hole is drilled 7¾ in. deep in 5 steps (2 parts at a time). A proximity switch stops machine if a drill should break.

Dial Index Machine #C-5117



VALVE BODIES

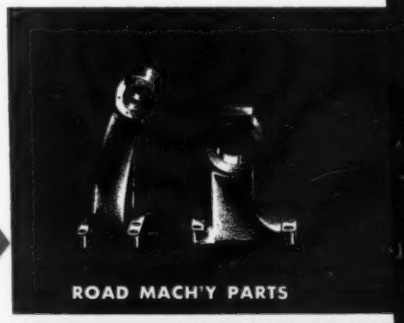
From 19 to 28 operations per part are performed on 32 different valve body styles on the same machine with only simple tool changes.

Trunnion Machine #C-5021

CONTROL ARM

A 4-station 3-way (2 horizontal, one vertical) dial index Economatic for drilling, reaming and facing control arms.

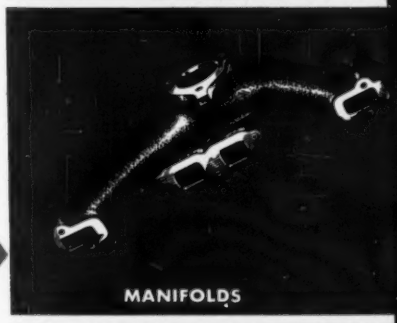
3-way Machine #C-4005



ROAD MACH'Y PARTS

7 different road machinery parts are produced on one automatic machine. Settings for different parts are pre-selected with a dial switch.

Shuttle-type Machine #C-4552



MANIFOLDS

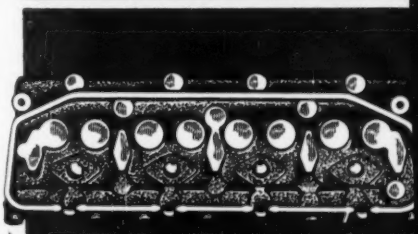
Cast manifolds (both LH and RH) are produced at a rate of one every 21 seconds on a 20-station machine.

Transfer Machine #C-4524

ALUMINUM OR CAST IRON

43 operations are performed on either aluminum or cast iron housings at 21 stations. Time cycle is 21 seconds per part.

Transfer Machine #C-4098



CYLINDER HEADS

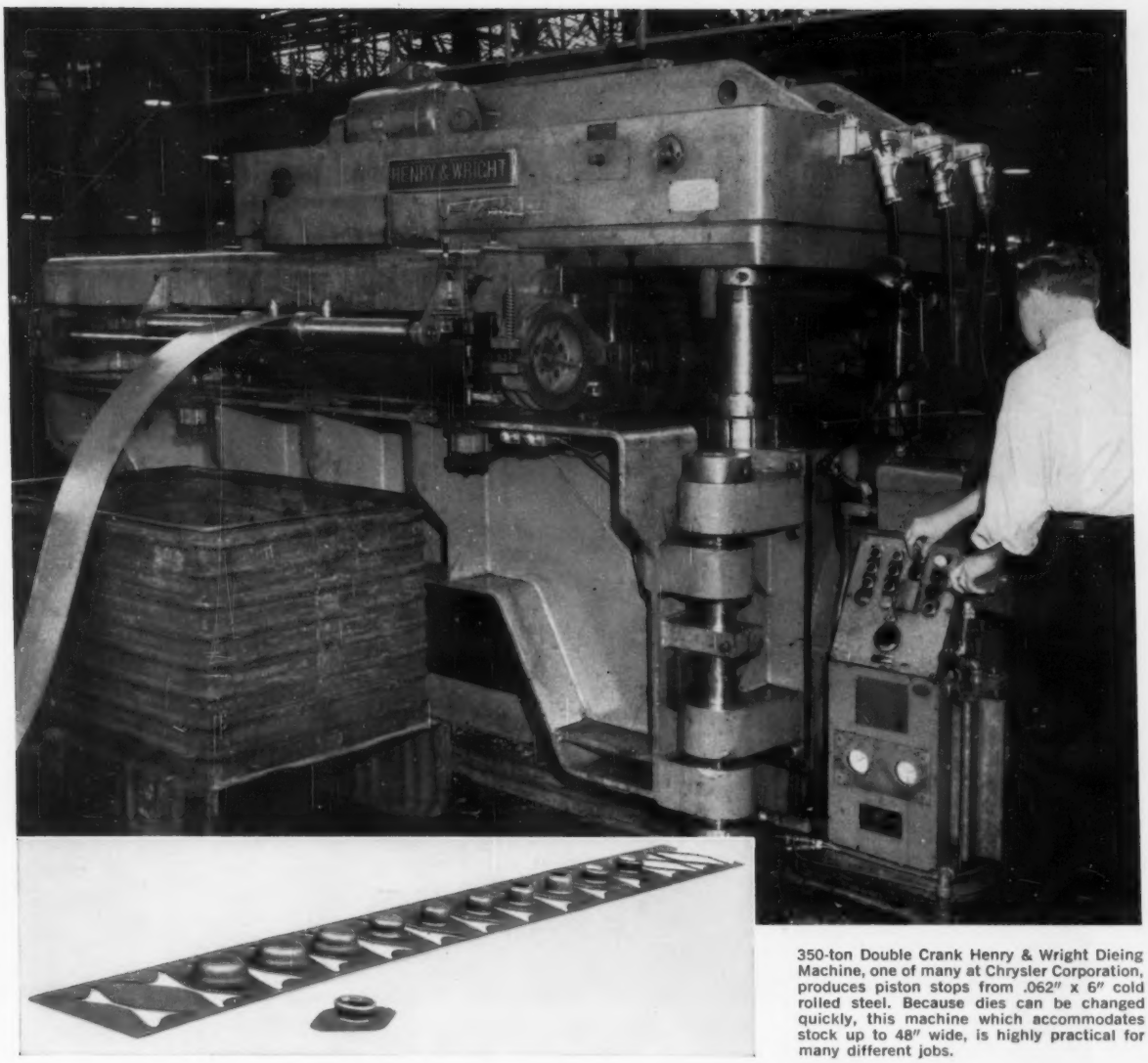
All spark plug holes are combination drilled and reamed on a simple 2-fixture 4-station machine with a 12-spindle head.

Single-station Machine #C-4941

Ask for more information by machine number

BUHR MACHINE TOOL COMPANY

ANN ARBOR, MICHIGAN



350-ton Double Crank Henry & Wright Dieing Machine, one of many at Chrysler Corporation, produces piston stops from .062" x 6" cold rolled steel. Because dies can be changed quickly, this machine which accommodates stock up to 48" wide, is highly practical for many different jobs.

Maximum Production . . . Maximum Savings

with Henry & Wright Dieing Machines

A single, versatile Henry & Wright can economically replace several conventional mechanical presses because they offer *more opportunity* for savings. Day-to-day production demands versatility, quick die changes with minimum down time, adaptability for either large or small parts — long or short runs.

Die life — a vital cost factor — can be lengthened with Henry & Wright's single or double crank dieing machines. Every feature is designed for proper die alignment, better, faster production.

Thousands upon thousands of extra parts before regrinding. All reciprocating parts are accurately guided assuring correct tool alignment and minimum wear. Because H & W's transmit power through the crosshead below the die bed, the pull-down stroke, guided by four guide rods, assures close control of the power stroke. Angular thrust from the crankshaft is received by the lower crosshead — cannot be transferred to the upper crosshead for possible punch misalignment. Saves on die regrinding — more uniform wear on tools. Reduced die clearance is also permissable—saves on die life and reduced cycle time.

Find out today how Chrysler and other major parts producers have capitalized on the many advantages of these fine machines. Write or call your nearest H-P-M field representative today.

THE HYDRAULIC PRESS MFG. COMPANY

A Division of Koehring Co.

Mount Gilead, Ohio, U.S.A.

H910

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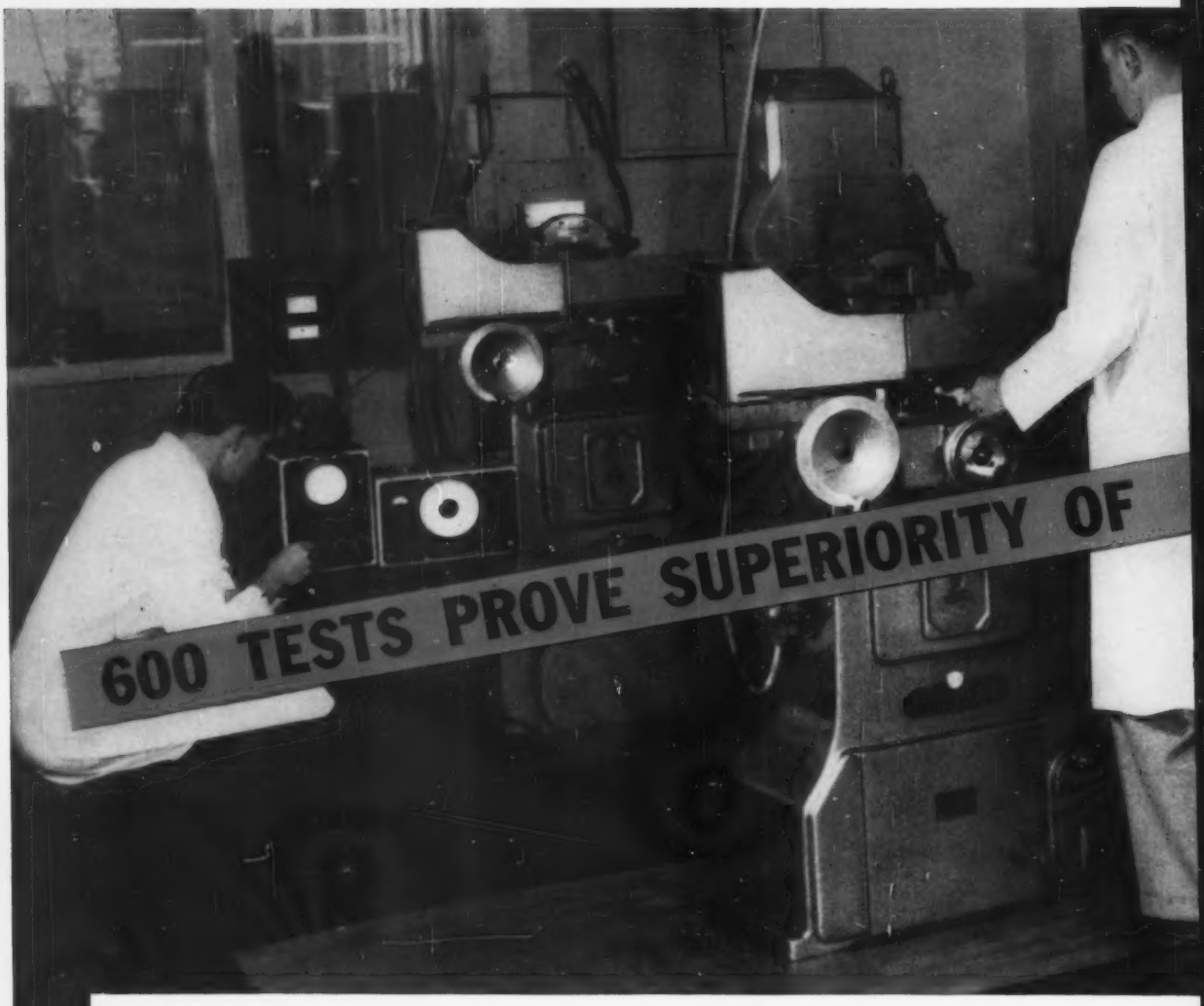

30% TO 50% LONGER LIFE FOR RESINOID-BONDED DIAMOND WHEELS

Six hundred separate trials, using 145 wheels, were run by the Diamond Research Laboratory to test a completely new type of natural diamond grit for resinoid wheels. The results: this new grit increases the life of natural diamond resinoid-bonded wheels by 30% to 50%.

The particles of this new grit do not readily pull out of the bond. Instead, they break down into ever-finer fragments which constantly expose new, sharp cutting surfaces.

TEST EQUIPMENT: Three 18″ Jones & Shipman production grinders were fitted with special spindles to enable wheels to operate at 5500 surface feet per minute, the speed generally used in diamond grinding.

The wheels were of the D1A1 type, 6″ in diameter, 3/16″ face width, with 1/8″ depth of resin. Each wheel contained 31 1/4 carats of the new grit. Metal to be ground was tungsten carbide of the same quality normally used for milling cutters, lathe tools, etc. During the course of the tests, 700 pounds of hardest carbide were ground away.

RESULTS: This new friable grit, Selected Natural Diamond (SND-RESINOID), increases the life of natural diamond resinoid wheels by 30% to 50%, depending on the type of job at hand. The grit will be available to your wheel manufacturer soon. Next time you order diamond resinoid wheels, specify SND-RESINOID . . . the most economical *and* the most efficient grit you can use.

Tests were run on these three Jones & Shipman production grinders. Results showed that the new grit, Selected Natural Diamond (SND-RESINOID), increases the life span of natural diamond resinoid wheels by 30% to 50%.

INDUSTRIAL DISTRIBUTORS (SALES), LTD.

YOU CAN DEPEND ON NATURAL DIAMONDS

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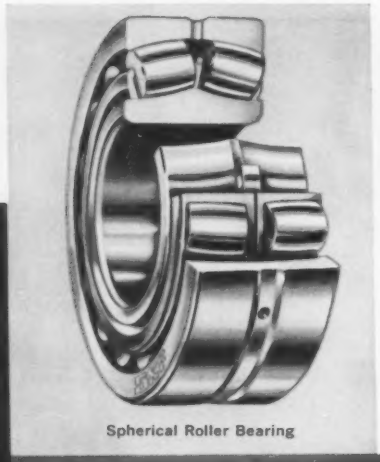
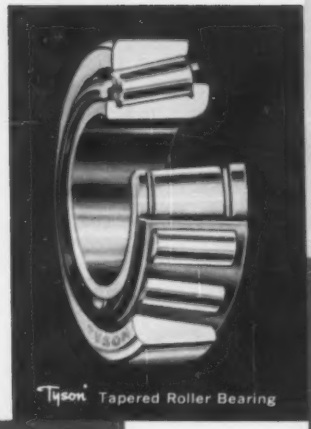


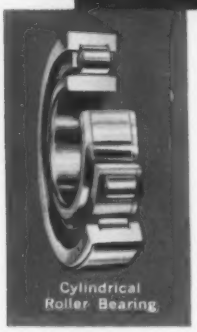
Spherical Roller Bearing



"Tyson" Tapered Roller Bearing

Spherical Roller Thrust Bearing

Single Row
Deep Groove Bearing



Cylindrical
Roller Bearing

Angular
Contact Bearing

When can a standard bearing do a "special" job?

Suppose you need a high speed bearing to support either heavy thrust load or thrust load combined with radial load. It is almost a certainty that SKF angular contact ball bearings will do the job.

SKF bearings of this type are produced in bore sizes ranging from ¾" to just over 7". They lend themselves to all sorts of mountings. For example, you can mount them in pairs either face-to-face or back-to-back where axial rigidity and high radial capacity are needed. Or you can mount two or more bearings in tandem, where a particularly high thrust capacity is required.

Yet this is a standard SKF bearing, promptly available in over 80 sizes of single- and double-row types.

Almost every SKF bearing can do "special" jobs for you. Why not find out how they'd be more efficient and economical? Call any one of the twenty-five sales offices.

5924

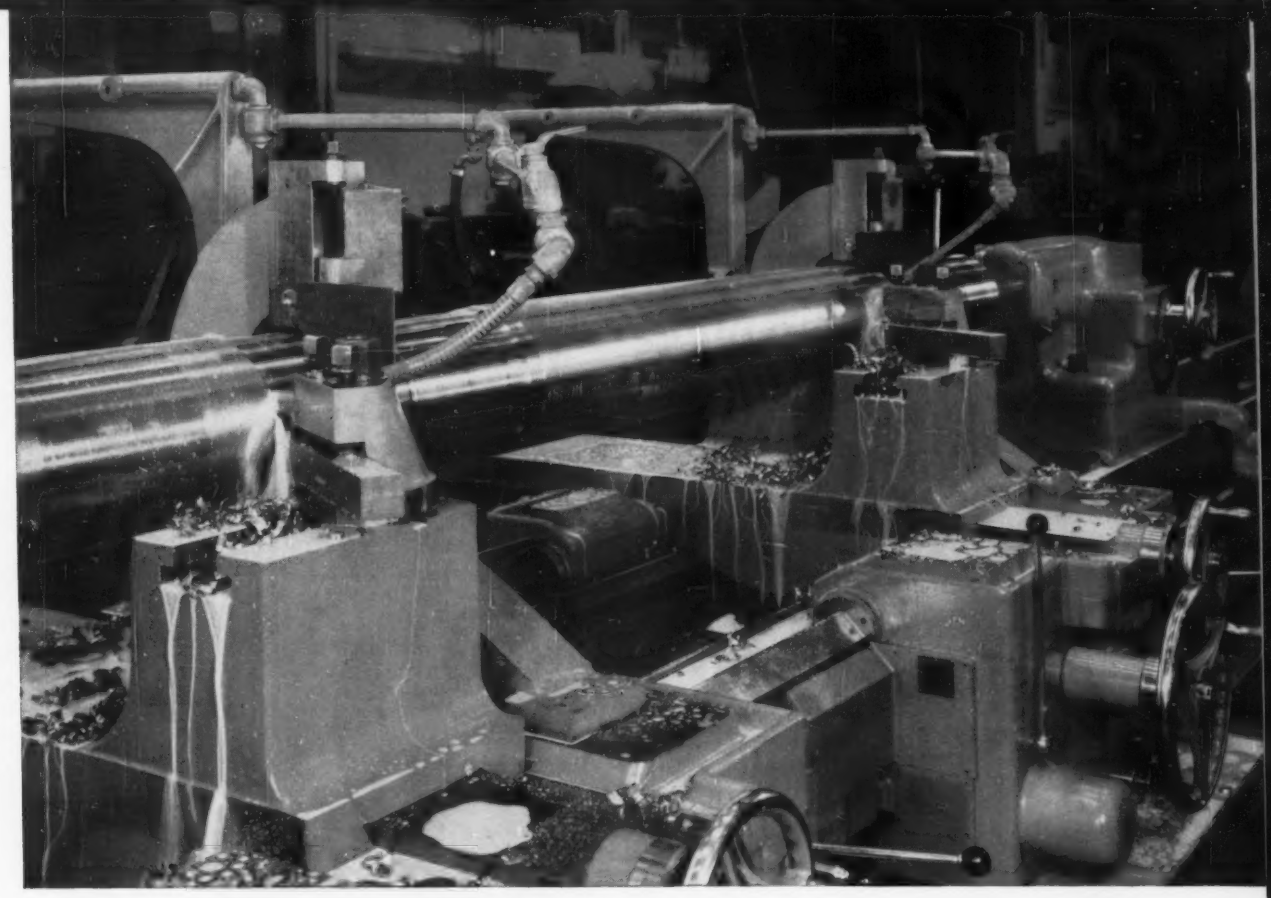
Spherical, Cylindrical, Ball, and "Tyson" Tapered Roller Bearings

EVERY TYPE—EVERY USE

SKF®

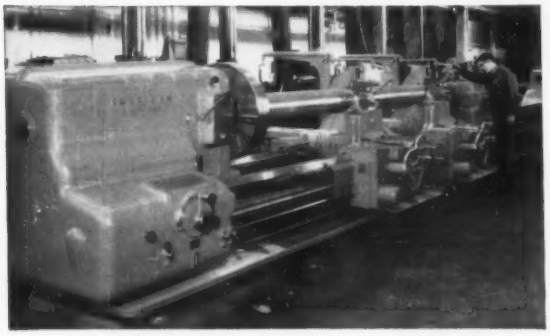
SKF INDUSTRIES INC. PHILADELPHIA 32, PA.

® REG. U. S. PAT. OFF.



Cutting with two Carriages equipped with plain block rests and follow rests.

MACHINING TITANIUM BILLETS



32 inch "American" Double Carriage Pacemaker Lathe.

An extremely difficult job — a real challenge to the rigidity, stamina and "staying" qualities of any lathe.

Cutting titanium offers terrific resistance to the cutting tool which in turn demands maximum rigidity of the tool supporting members in order to hold vibration to the very minimum; otherwise chatter and high tool mortality are inevitable.

The fact that all of the major titanium fabricators are using "AMERICAN" Lathes, selected only after repeated demonstrations, is conclusive testimony to the power, stamina and rigidity of these machines.

There are exclusive features which definitely contribute to this result, such as the wide, four vee bed with walls rigidly tied together between the girths by an angular web which forms a chute for quick disposal of chips; replaceable hardened tool steel vees; solid 3-vee mounting of the carriage on the bed; powerful headstock with triple bearing spindle and bearing adjustment from the outside and others which space limitations prevent mentioning.

For a complete description of all of these features just send for bulletin No. 144.

THE AMERICAN TOOL WORKS CO. Cincinnati 2, Ohio, U.S.A.

LATHES AND RADIAL DRILLS

UNIVERSAL JIG AND FIXTURE COMPONENTS AND CLAMP ASSEMBLIES

Shown here are a few of more than a thousand different items in regular steel and stainless steel —the largest and most complete selection in the United States—now available from Universal Engineering Co. Write today for your copy of the complete, new catalog.

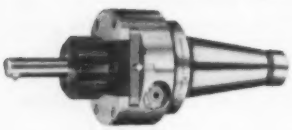
213

OTHER PRECISION-BUILT COST SAVING UNIVERSAL PRODUCTION TOOLS

Floating Chuck

Standard Collet Chuck

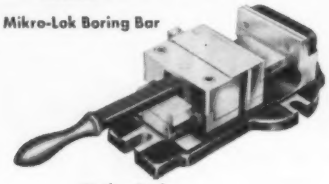
Mikro-Lok Boring Bar



Boring Chuck

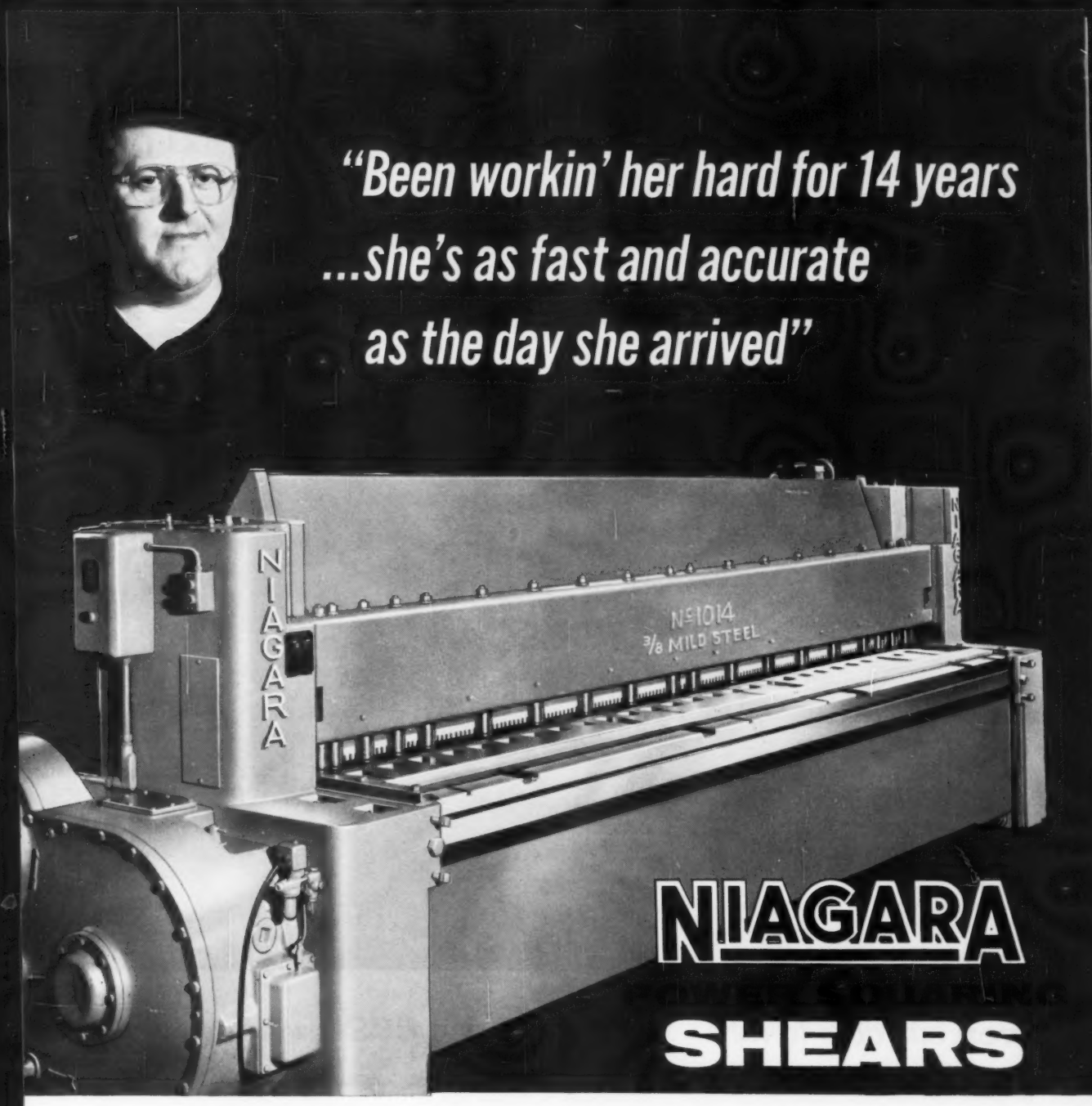
"Kwik-Switch" Tool Holder

Standard Drill Bushing



Wedge-Lock Production Vise

UNIVERSAL ENGINEERING COMPANY, FRANKENMUTH 2, MICHIGAN



Precision made Niagara Shears are built to cut with micrometer accuracy . . . *and to keep cutting that way.*

Thousands are in use, but comments are nearly identical. Makes no difference how hard they're worked. Three shifts a day, month after month, year after year . . . a Niagara Shear *continues* to be accurate.

"Don't have to change knife clearance"

No adjustments needed for cutting different thicknesses of stock . . . even at the same time . . . with consistently accurate, burr-free results. *And much longer knife life!* The secret is in the rigidity of Niagara's exclusive box section design. "Upped production 25%," says one user, "because we have fewer adjustments to make."

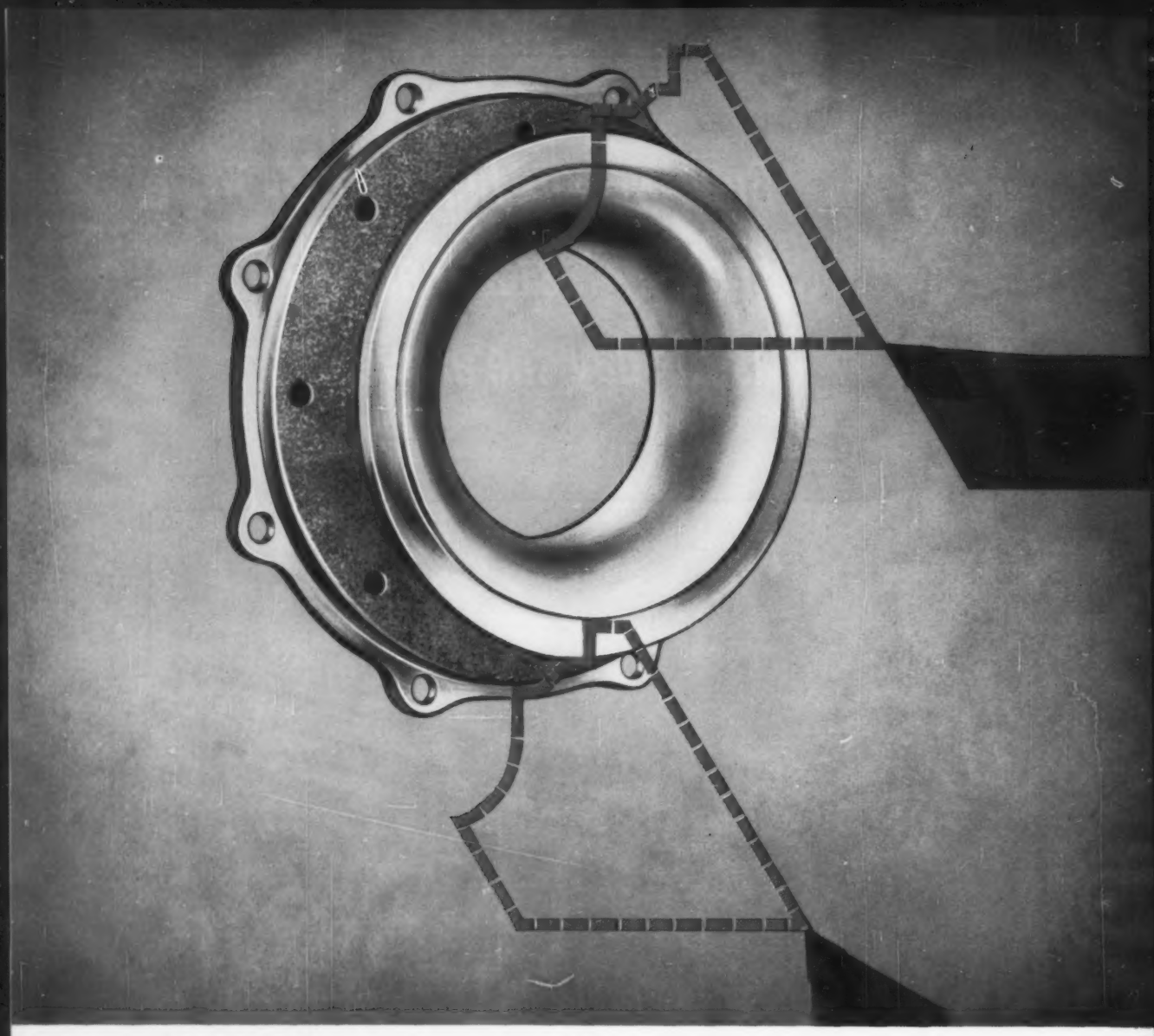
"Costs less to operate"

There's less to do, less to learn and less to go wrong. Never even have to worry about damaging the machine by forgetting to change the knife clearance. Once set, Niagara Shears need no further adjustment. "Been using Niagara's for 10 years . . . never had downtime for repairs or maintenance," says another user. Even after long, hard use when it becomes necessary to turn the blades or change knives, it's a very easy matter. Nothing like Niagara Shears for simplicity.

FACT BOOK FOR YOU

Bulletin 69 is filled with customer reports on Niagara Shear performance. You'll value it. Write today.

NIAGARA MACHINE & TOOL WORKS • BUFFALO 11, N. Y. *District Offices and Distributors in Principal Cities*



seven *surfaces to turn:* **one** *template,* **one** *slide,* **two** *tools.*

Machine tools are rarely if ever bought because somebody thinks they might come in handy. They are bought because a specific job needs to be done and because a particular machine is judged best fitted to do it. However, no matter how specific your need may be, *versatility* is the greatest by-product you can buy, and the greatest assurance of a profitable investment.

Perhaps your problem is economical, long-run production of a contoured shaft piece. Well and good: your best bet is a New Britain **+GF+** copying lathe. Now let's suppose you develop a requirement for only a few hundred pieces like the one illustrated. Your New Britain **+GF+** is every bit as efficient. Simple tooling; fast setup; rapid, accurate production.

The applications for contour turning are very broad. If you have contour turning, boring and facing work on shafts or chucking work, you should be interested in the New Britain **+GF+**. Many shops whose production requirements wouldn't justify very expensive, lightning-fast production can make highly profitable use of one of the basic models because of its versatility, accuracy, fast setup and inexpensive tooling. At the other end of the scale,

you can't touch our machines for tremendous volume work. Obviously, this subject is much too broad and too important to do justice to it here. We would like to send you literature that spells things out in much more detail. New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Connecticut.

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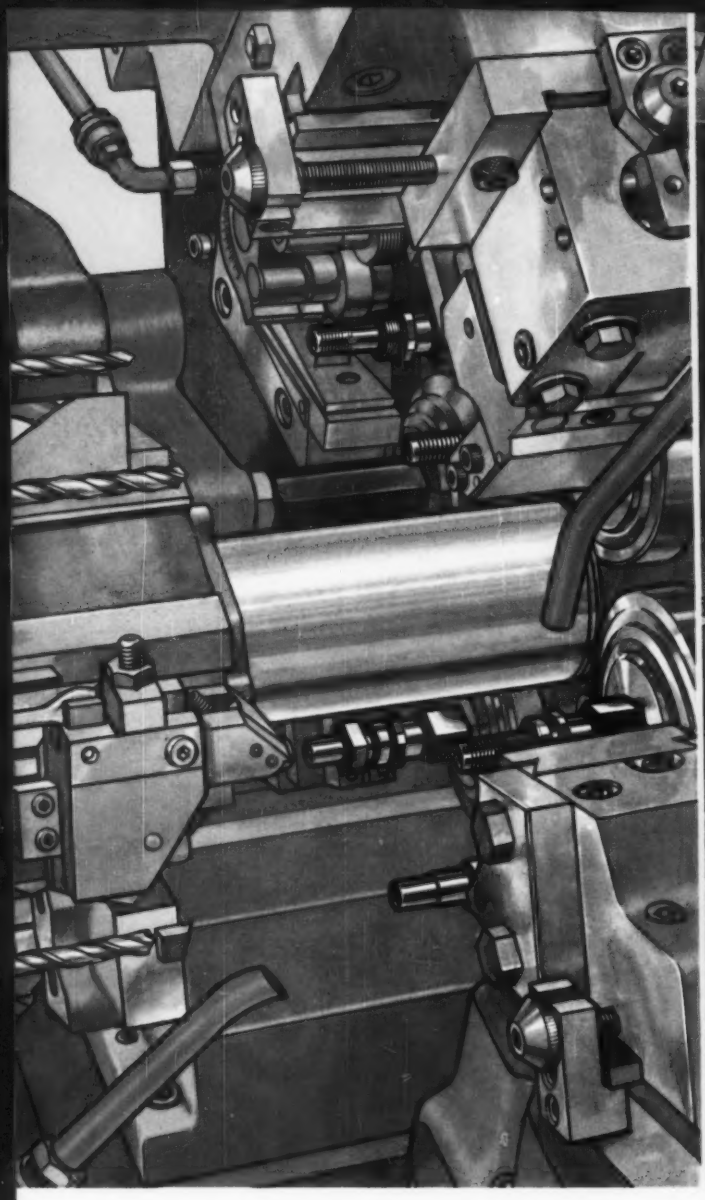
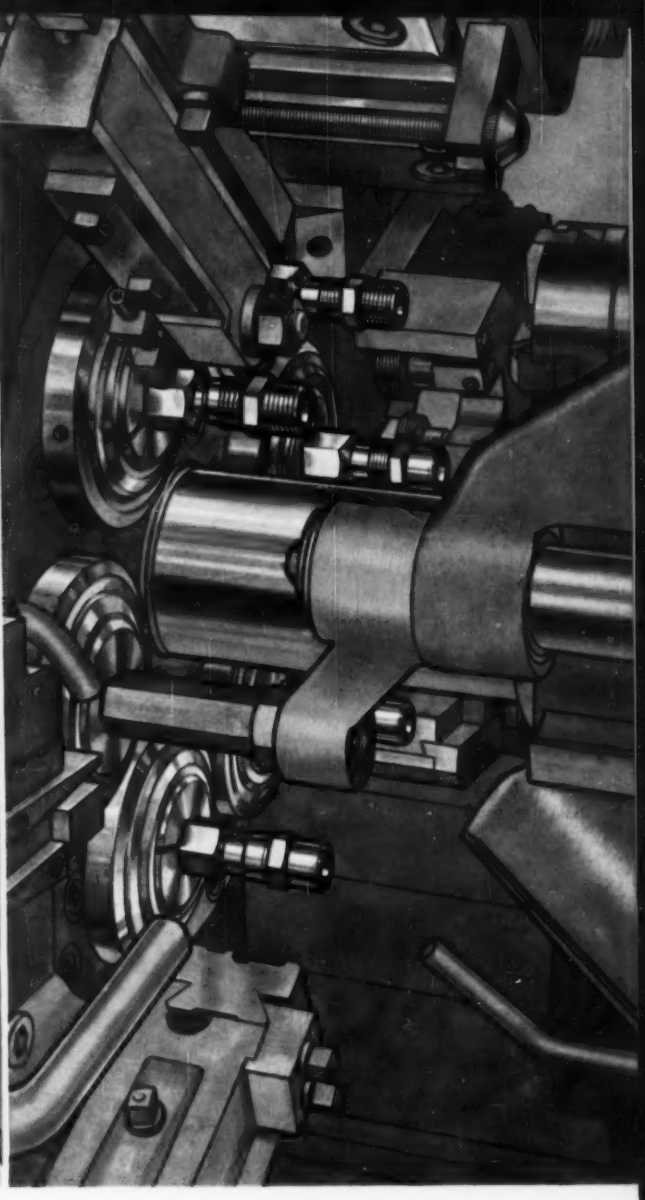


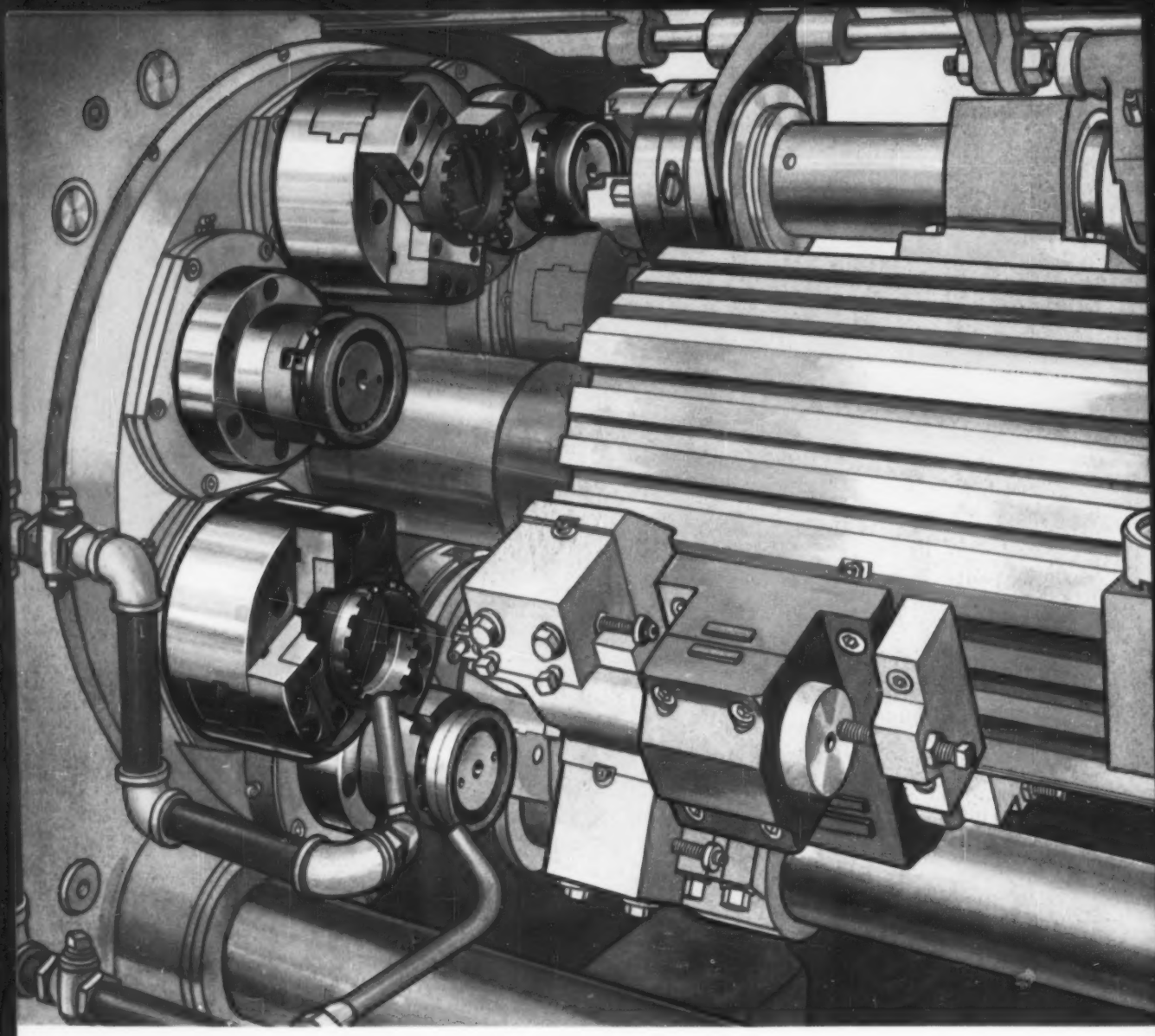


stainless, **225** *per hour—brass* **1500** *per hour.*

Up to a point increased machine productivity is a matter of refinements, additions, skillful tooling and perhaps more power. Eventually you achieve about all the efficiency that can be built into equipment of conventional design.

To achieve a major break-through in bar machine productivity necessitated redesign from the ground up. New Britain has done it with such success that we are able to offer the metalworking industry a whole new family of machines with performance unequalled anywhere. Independently cammed cross slides open up a whole new world of tooling possibilities. Power and spindle speeds are adapted to the important new metals and alloys. Increased chucking capacity allows application of New Britain standards of speed and accuracy to much larger pieces. None of the famous New Britain exclusive features which preserve accuracy and increase accessibility over other machines have been sacrificed. The chart below tells part of the story, and we have complete literature available to spell it out completely on the models which interest you particularly. New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Connecticut.

Model	Spindles	Cross Slides	Spindle Speeds	Spindle Capacity	H.P.	Weight
45	4	4	43-526	5″	30-50	46,000
52	6	6	271-4250	1 1/4″	15-25	12,800
62	6	6	177-3000	1 5/8″	15-30	18,800
62	6	6	177-3000	2 1/4″	20-30	18,875
82	6	6	64-633	3 1/2″	30-50	46,000
83	8	6	99-1504	2 5/8″	30-50	46,000



open secret *of New Britain superiority.*

Wide-open design makes the most fundamental difference between a New Britain automatic chucking machine and other machines. It speaks for itself as a means of getting at the tooling, making adjustments and clearing chips.

Massiveness, right from the floor up, is equally apparent and equally important in chucker work. You see it in the way the cutting tools make the heaviest cuts with a chatter-free smoothness that can't be duplicated.

Only New Britain provides a combination of longitudinal with transverse forming motion where needed. This versatility eliminates the need for second operation machines in many cases —particularly when a job is setup for double indexing, as illustrated above.

New Britain spares no pains to incorporate every new development to make chucker-type machining more profitable. The open-end design lends itself particularly well to magazine loading and unloading, for example, and many New Britains are being equipped to provide this feature.

Whenever a number of operations are required on cast or forged pieces, these massive, rugged, powerful machines offer great possibilities for savings through faster, more accurate, more reliable production. A new and complete catalog on the New Britain chucker line is just off the press. We would be very glad to send you your copy. New Britain-Gridley Machine Division, The New Britain Machine Company, New Britain, Connecticut.

Announcement

New Britain's new and completely modern Rebuild-Retool Center at Bridgeport, Michigan, is important to every present and prospective owner of New Britain Automatics.

This is the first center established exclusively for the rebuilding and retooling of production machinery. It is staffed by men trained specifically for this type of work. It is equipped specially for putting New Britains back on the job with maximum efficiency in minimum time, at minimum expense to the owner.

Rebuilding and retooling may be "orphan jobs" elsewhere, but they rate top treatment at New Britain. Here is an important extra reason for selecting a New Britain when you purchase new equipment—a full time specialist organization devoted to protection of your investment.

If you would like to investigate the profit potential in a complete modernizing program, or could profit from a factory-engineered retooling of one or more machines, write us either at New Britain, Connecticut, or Bridgeport, Michigan. The New Britain Machine Company.

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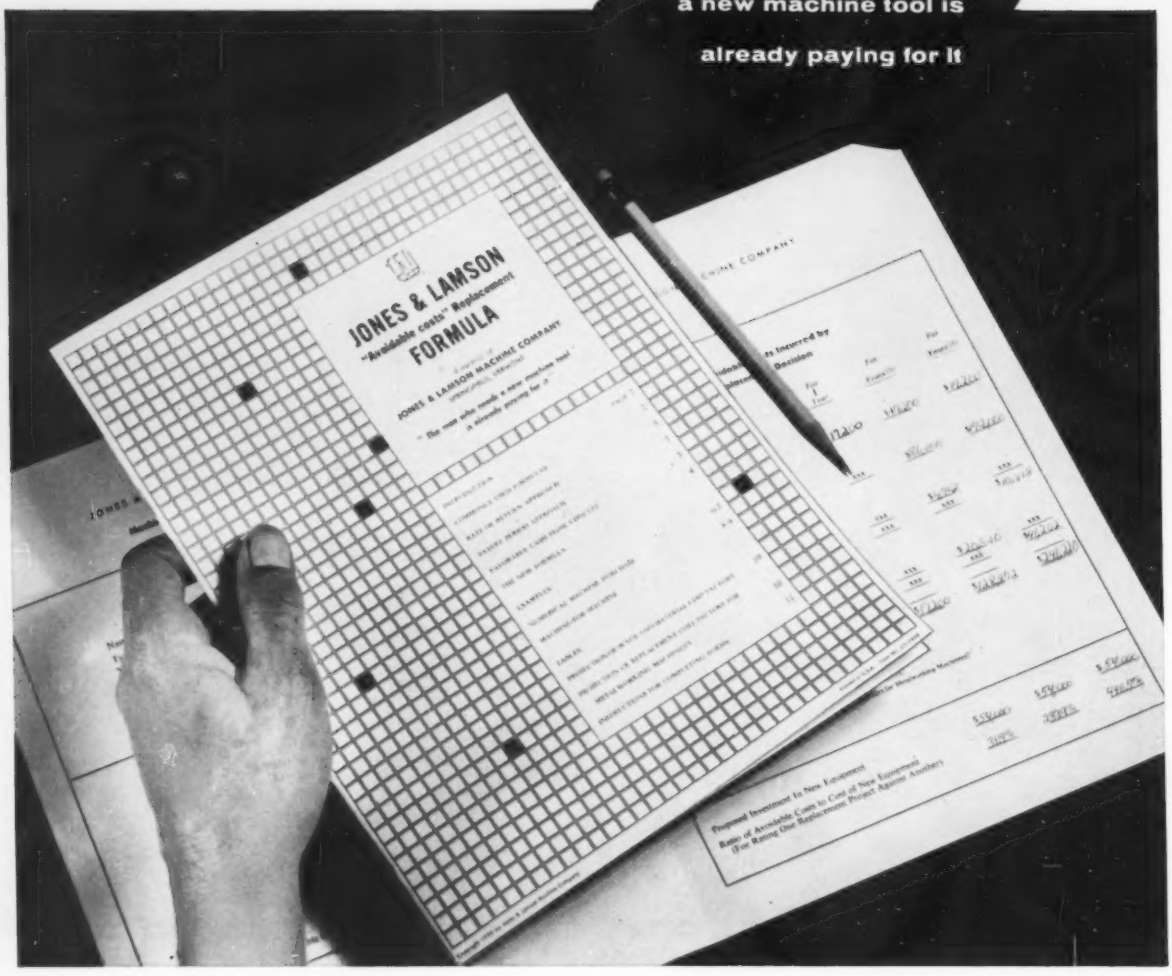
JONES & LAMSON MACHINE COMPANY

the man who needs a new machine tool is already paying for it



How to get Equipment Dollars from Management

To management men, nothing speaks so eloquently as facts. Take the men in *your* front office, for instance. When told that a new machine tool (or several new ones) is a "must", they may very well be inclined to agree. But they have to be *shown*.

In order to sell management, you must present an accurate, factual statement, comparing current productivity of existing equipment, with the productivity attainable with new, advanced equipment.

And this is where you must exercise extreme caution.

Why?

Because, practically without exception, the formulas commonly used for evaluating machine tool performance contain flaws, fallacies and limitations which are seriously misleading. They give an erroneous picture because they distort the facts.

Happily, J & L has the answer to this problem. It's the new J & L "Avoidable Costs" Replacement Formula, which gives you an easy, step-by-step method of productivity evaluation which is logical, accurate and reliable. This formula is tried and true. It gives you a clear, true picture and supplies you with the facts you need in order to get that new machine you're looking for.

For your copy of J & L's "Avoidable Costs" Replacement Formula, together with easy-to-use work sheets, write Jones & Lamson Machine Company, 512 Clinton Street, Springfield, Vermont.

Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools

This Standard Oil product made better grinding possible at Cessna

Aircraft Company's Industrial Products Division licked three problems with ARGON Oil No. 4

Situation: A fluid used in grinding operations at this Cessna plant at Hutchinson, Kansas, was creating three problems:

1) It washed the lubricant from regulator wheels and grinding fixtures, causing them to freeze.
2) It caused build-up of deposits.
3) It stripped paint from machine surfaces.

What was done: Cessna management called in a Standard Oil lubrication specialist who recommended ARGON Oil No. 4 in ratios of 100 and 150:1 for test. The coolant was tested in two centerless grinders for two months.

What happened: All three conditions which were hampering operations were cleared up when the switch was made to ARGON Oil No. 4. Cessna also found that work remained rust-free after passing through the machines, something that had not been the case before. They also found that the coolant didn't foam. With no foam, more of it stayed on the wheel, resulting in cooler operation. Faster cuts were obtained with finer wheels. All 12 grinders in the Cessna shop were then converted to ARGON Oil No. 4.

What you can do: Get more facts about ARGON Oil No. 4 from the Standard Oil office near you in any of the 15 Midwest or Rocky Mountain states. Or write **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**

Quick facts about **ARGON Oil No. 4**

• Clear, transparent fluid • Able to control corrosion and rust on work and machines • All chemical. Does not support bacteria growth • Unaffected by humidity • Fire resistant • Odorless

You expect more from **STANDARD** *and you get it!*

Jerry Croes, Standard Oil staff engineer, Paul Hoyer, Cessna section superintendent and Bill Ray, Standard Oil lubrication specialist (l. to r.) inspect rust-free finish after grinding with ARGON Oil No. 4 while J. E. Petrie (far left), operator, looks on. Both Jerry Croes and Bill Ray have plenty of experience in this sort of work. Jerry has been at it for 16 years. He has an engineering degree from South Dakota School of Mines & Technology and has completed the Standard Oil Sales Engineering School. Bill has six years service working with industrial customers.

NEW...
from Skinner!

3-way, high-flow, solenoid valves for general industrial use

Main orifice sizes: full effective—⅜", ½", ¾" for ⅜", ½", ¾" NPT.

Standard operating pressures: 5 to 150 psi.

Media: oil, air, water, vegetable and petroleum oils, inert gases, kerosene, gasoline.

Types: normally open, normally closed and directional control in standard and explosion-proof construction.

These new, 3-way L3 Series valves, like all Skinner valves, are built to UL standards. Their bodies are made of forged naval brass and their internal parts are stainless steel and brass. Soft, synthetic inserts and seals provide bubbletight sealing. And a unique, Buna-N coated nylon diaphragm assembly assures long life. The valves are compact, light, and mount in any position, directly to the line. They are offered in a wide range of voltages and frequencies, with many electrical options and manual override.

Typical applications: air vises, chemical process equipment, presses, water treatment equipment, industrial machinery, packaging machinery, air and hydraulic cylinders, laundry machinery, etc.

Skinner solenoid valves are distributed nationally.

For complete information, contact a Skinner Representative listed in the Yellow Pages or write us at Dept. 558.

SKINNER ELECTRIC VALVES

THE CREST OF QUALITY **THE SKINNER ELECTRIC VALVE DIVISION • NEW BRITAIN, CONNECTICUT**

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- 380,000,000 Customers . . . in India
- More Customers . . . Right Here!
- Import Pattern Set?
- Dispersal Program Dormant
- Washington Briefs

Keeping up with Washington

Loring F. Overman

GLOWING WORD PICTURES of opportunities in India for American manufacturers of machinery, tools, and dies—among other commodities—were projected recently before a large group of Cleveland businessmen. The occasion was a conference to discuss a final report of the United States Trade Mission to Calcutta and eastern India. The mission is one of seventy-one in which five-man teams representing business and government have been visiting 500 cities in thirty-nine countries, establishing personal contacts with foreign businessmen. The report from India was particularly interesting because it disclosed an almost unlimited necessity for expanding production facilities to meet the growing needs of 380,000,000 people. Machinery-industry representatives on the Calcutta tour were Herbert C. Murrer, president, Murrer Tool Co., Cincinnati, and David B. Hanna, consultant, Union Metal Mfg. Co., Canton, Ohio.

More Customers . . . Right Here!

The Commerce Department and the Securities and Exchange Commission report that plant and equipment expenditures for the year will be some $800,000,000 more than the $31,800,000,000 predicted only three months ago. The new estimate, if reached, would put expenditures 7 per cent above the 1958 total. The trend is already noted in new orders for metalworking machinery —56 per cent above the first quarter of 1958—according to a joint report of the Census Bureau and the Business and Defense Services Administration. This year's orders consist of $122,000,000 worth of cutting type machines and $45,000,000 worth of forming and shaping types, as against $81,000,000 and $26,000,000, respectively, for the two categories in the same period last year.

Import Pattern Set?

The proposition that imports of heavy electrical machinery constitute a threat to national security has been rejected in a "Memorandum of Decision" issued by the Office of Civil and Defense Mobilization. American manufacturers of power generating equipment had protested recent awards of government contracts to English firms. The OCDM decision, announced after more than a year of study, concerns imports of hydraulic turbines, hydraulic turbine-driven generators, transformers, and circuit-breakers. The decision does not cover steam turbines and generators, which are being studied under the national security clause of the Trade Agreements Act.

Leo A. Hoegh, OCDM director, has indicated, however, that he will keep the importation of hydraulic generators under continuing study. Such observation is necessary because of the industry's special skills, its engineering methods, and because its elephant machine tools are important to the nation's mobilization base. A trend toward substantially greater reliance on foreign-produced turbines, he contends, could have an adverse effect on national security.

Dispersal Program Dormant

Mr. Hoegh told the Congressional Joint Defense Committee that proposals to disperse defense industries as a bulwark against nuclear attack are now inactive. The question was raised by East Coast Congressmen on the grounds that too much aviation and missile work has been concentrated in western states. Although conceding that a nuclear attack would be disastrous to concentrated industries, Hoegh observed that normal economic factors act as powerful stimuli to continued expansion in already-active areas. Between July 1952 and January 1959, plant decentralization was encouraged by permitting accelerated depreciation, for tax purposes, in dispersed areas. More than 1600 applications for rapid amortization were granted, involving approximately $17,000,000,000. This program is now virtually inactive, being limited to only the most direct defense type applications.

Washington Briefs

Increased hiring in heavy industry is cited by the Departments of Commerce and Labor as a reason for the continued drop in unemployment totals.

Increased use of electronic data computing machines depends on training management and administrative employes to correctly evaluate the objectives and accomplishments of the machines. Builders of the machines are now reportedly ahead of the market. A vast expansion in the production and use of the equipment could follow a wider understanding of its functions.

Changing the base of statistical reports from 1947-49 to 1957-59 is proposed by the Office of Statistical Standards, Bureau of the Budget. The effect of the change in many cases would be to reduce index numbers to relatively small additions to the number 100. The present base was adopted in 1951 at the suggestion of the Budget Bureau. Preparation of a new base would start in 1960, since figures through this year are needed.

"Research Relations between Engineering Educational Institutions and Industrial Organizations" is the title of a booklet released by the Small Business Administration. The publication points out that nearly $10,000,000,000 was spent on research in 1958, compared with less than $500,000,000 in 1949. How industry and educational institutions have worked together in the past is outlined, and there are suggestions for making the arrangement increasingly productive. Copies of the booklet, No. 23 in the SBA Management Series, can be purchased at 20 cents each from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

HARDINGE
ELMIRA, N.Y.

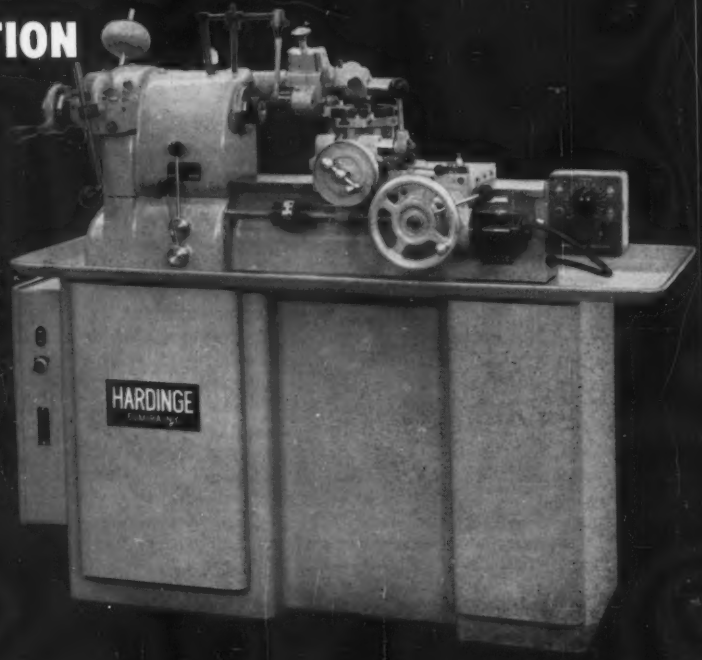
HARDINGE EASY READING BLACK and WHITE DIALS

mean INCREASED PRODUCTION

. . . **HARDINGE** developed these fast setting easy reading **black and white dials** they assure maximum accuracy with high production.

Pioneered with the Hardinge High Speed Precision Chucking Machine model-HCT shown here — **Hardinge black and white dials** are now standard equipment at **no extra cost** on all of our tool room and production machines.

Invest in Hardinge equipment for product improvement and increased production. Ask for bulletin on our tool room and production machines.



HARDINGE BROTHERS, INC.
ELMIRA, N. Y.

Machinery
AUGUST 1959

Postponement Costs Money

WHENEVER the purchase of capital equipment is contemplated, business executives invariably base their final decisions upon the economies that will immediately result from such a transaction. Little thought is given to the advantages that will accrue during future years from a new machine tool or other fabricating equipment bought at once. In these years of inflationary movements, when the cost of everything seems to constantly go higher, this is a factor of real importance.

Suppose a concern thinks about buying a new machine tool now but decides to postpone such action for several years. The chances are strong that the machine will cost more then. In the meantime, the company will have lost substantial profits that would have been earned by the modern equipment. The longer the delay is projected into the future, the greater the monetary losses. In calculating such losses, consideration should be given to higher labor, fringe, and material costs.

All factors relating to the future costs and profit losses resulting from the use of inefficient equipment are considered in an analytical method of replacement calculation recently developed by the Jones & Lamson Machine Co. The method does not involve the use of mathematics and is therefore more of an evaluation than a formula.

It does not analyze a replacement project in terms of the rate of return on investment in the new equipment, the period of time it will take to return the investment, or the period of time it will take to obtain a favorable cash flow. Rather, it analyzes a proposed replacement project in terms of avoidable costs which would be incurred by postponing the replacement decision for one, five, or ten years. It has built into the computation projections of increases in labor and other costs for these periods of time and also a projection of the increase in price of the new equipment for similar periods of time.

One of the greatest hidden risks in production operations is the high cost of not replacing equipment that is unprofitable, simply because it can still run. If a new machine is needed to cut down costs, the company is already paying for it in lost profits!

Charles O. Herb

EDITOR

What's the lowest cost way to produce steel parts like these?

You may be paying considerably more than you need to for parts like these if you aren't taking advantage of Ryerson flame-cutting service.

Size makes no difference—nor intricacy of shape. You can order one part or one thousand and get quick delivery of steel cut to close tolerance—with almost die-cut accuracy from piece to piece. And here's where the saving comes in:

1. **No dies or molds** are needed so you save this cost when you switch from cast or forged parts to flame-cut parts.
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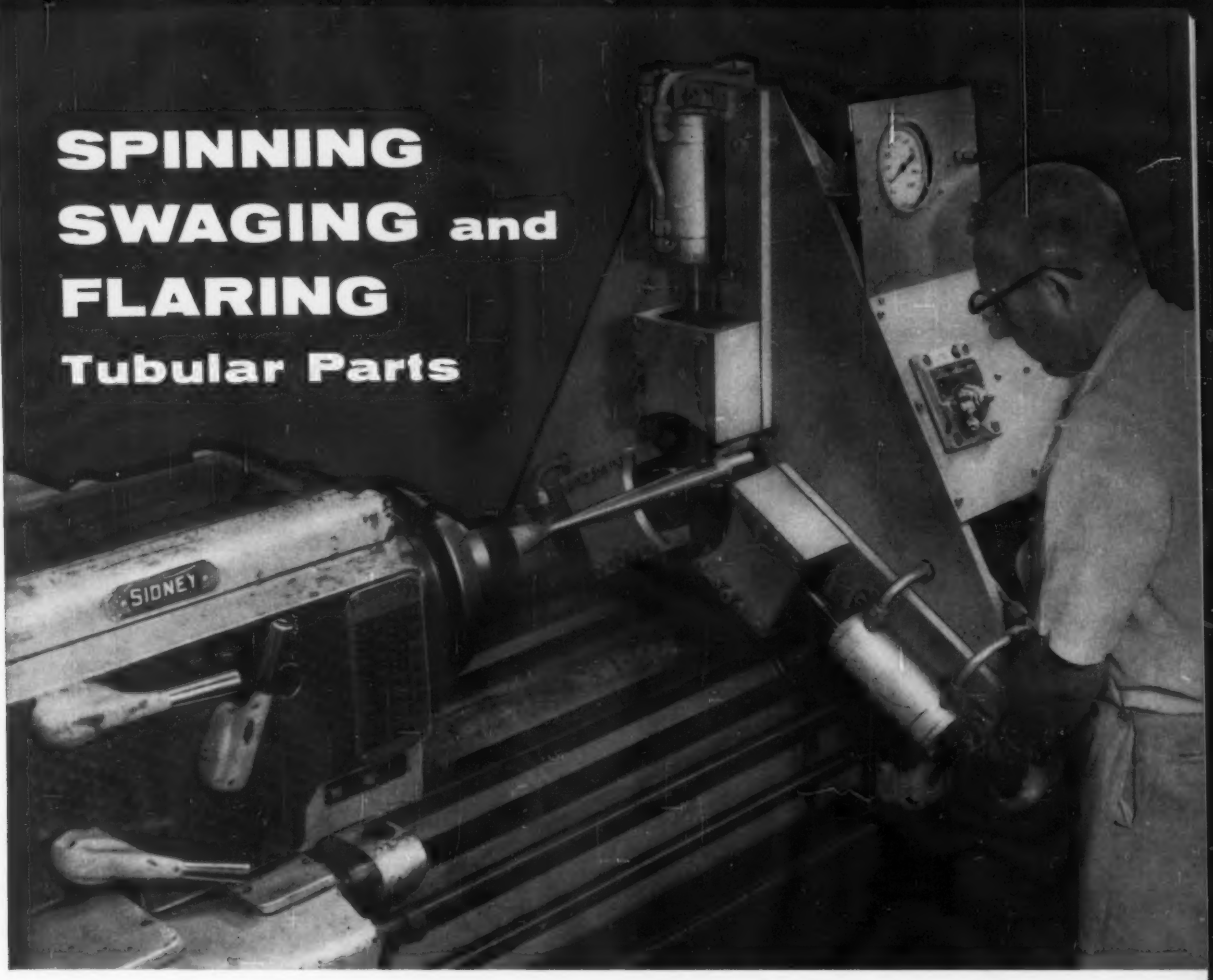
SPINNING SWAGING and FLARING Tubular Parts



Unique practices of the Douglas Aircraft Co. in manufacturing airplane components

CHARLES O. HERB, Editor

INGENUITY is the valuable asset of tool designers that must be called upon whenever products are demanded that cannot be made by standard or available equipment. Such occasions arise frequently in aircraft factories and the results achieved depend greatly upon the imagination of the personnel in the tool engineering departments. This article will describe several processes developed at the El Segundo, Calif., plant of Douglas Aircraft Co., Inc., that come within the category mentioned.

The first of these processes consists of forming stainless-steel venturi tubes to the shape seen at the bottom of Fig. 1, by using a Sidney engine lathe set up as shown in the heading illustration. It will be seen that the machine is provided with a special fixture equipped with three tapered rollers. This fixture is mounted on the regular cross-slide of the lathe. The rollers reduce the diameter of the tube to tight engineering standards as the fixture is fed along the lathe bed. Within the tube is a two-piece mandrel that supports the thin tubular wall during spinning and insures dimensional accuracy.

One end of the tube is flared before it reaches the lathe. This end is placed on a short section of

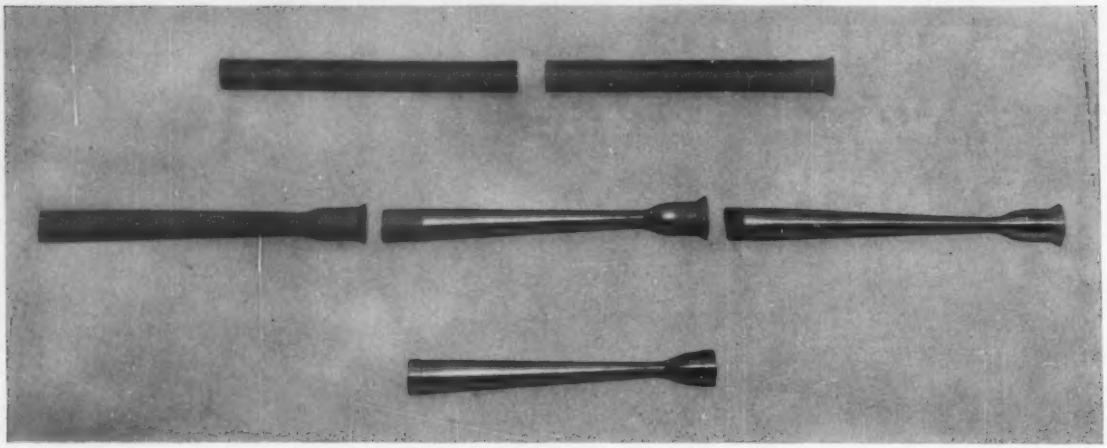


Fig. 1. (Above) Stainless-steel venturi tubes which are formed from straight tubing into the finished part seen at the bottom of the photograph.

Fig. 2. (Right) Three mandrels, each of two-piece design, are used in rolling venturi tubes into their tapered shape.

the mandrel which is mounted on the lathe spindle, the construction of the mandrel being apparent from Fig. 2. Three different mandrels are shown here. The long section of the mandrel is inserted in the portion of the tube to be tapered. When the work is placed in the lathe a reduced end of the long mandrel is entered into a hole in the short mandrel. Then the tailstock center is advanced to push the mandrel parts well together and to support them during the operation. The flared end of the tube fits snugly on the short mandrel section. It is retained by means of a large threaded collar that slips over the tube end and engages threads on the mandrel.

After the tube is loaded, three rollers on the special fixture are moved radially toward the work under hydraulic pressure with the operation of a valve control. Each roll is held against the work at a pressure of approximately 500 pounds. At the end of the operation, the rollers are retracted automatically.

The tubes in Fig. 1 have a wall thickness of 0.035 inch. They are reduced to the desired taper diameters in three minutes. The maximum length of tubing that can be handled with the equipment illustrated is 3 feet. The smallest tubing diameter that can be accommodated is 1/2 inch; the largest diameter is 4 inches.

Research has indicated that a 30 per cent reduction in diameter is about the limit. When a

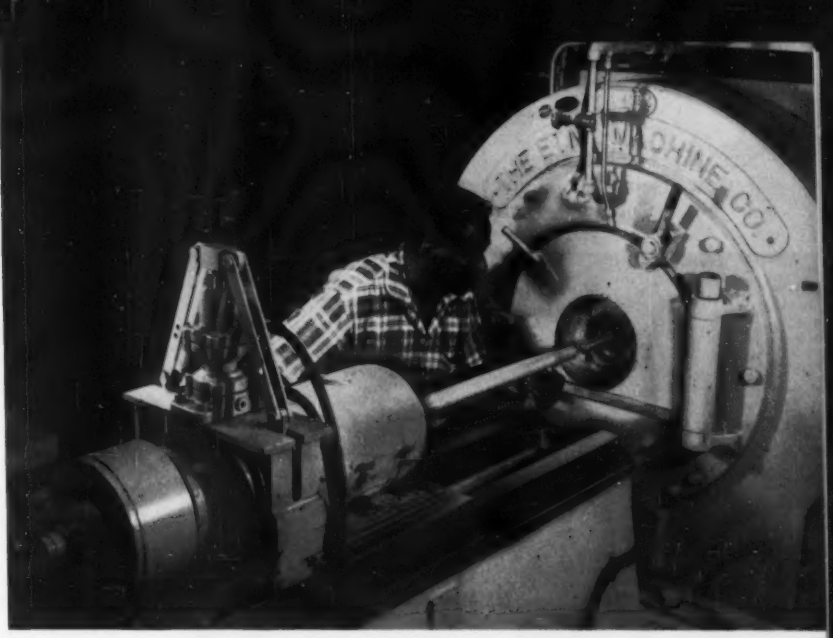


Fig. 3. A mandrel is also employed in swaging the ends of tubular parts to insure close dimensional accuracy of the hole portion of the swaged ends.

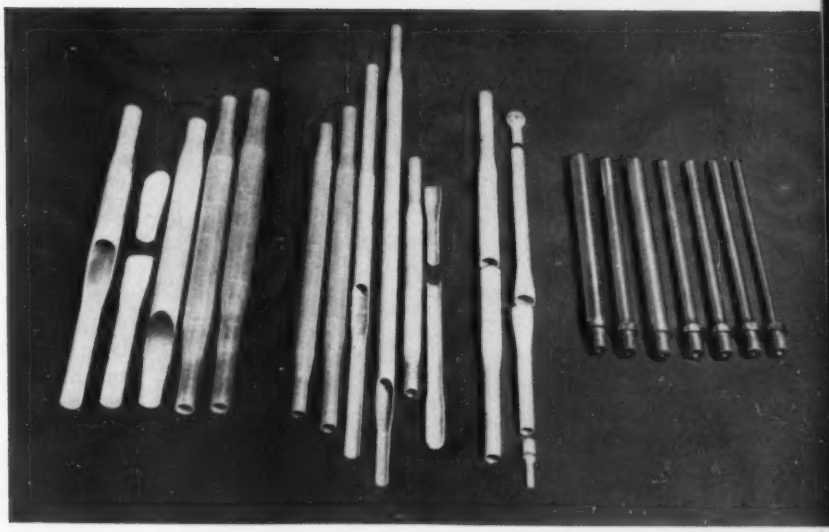


Fig. 4. At the left are seen a quantity of tubular parts that have been swaged to size on mandrels, and at the right, a series of mandrels.

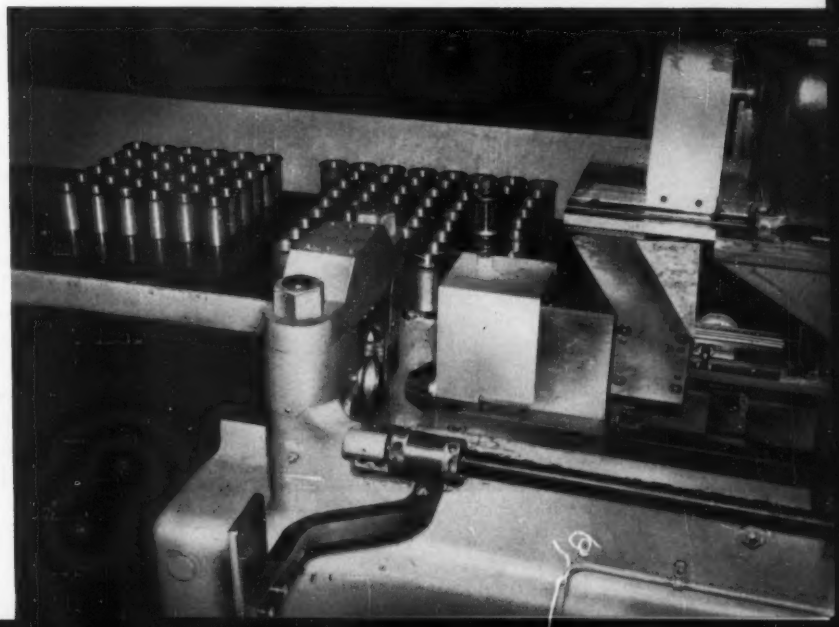
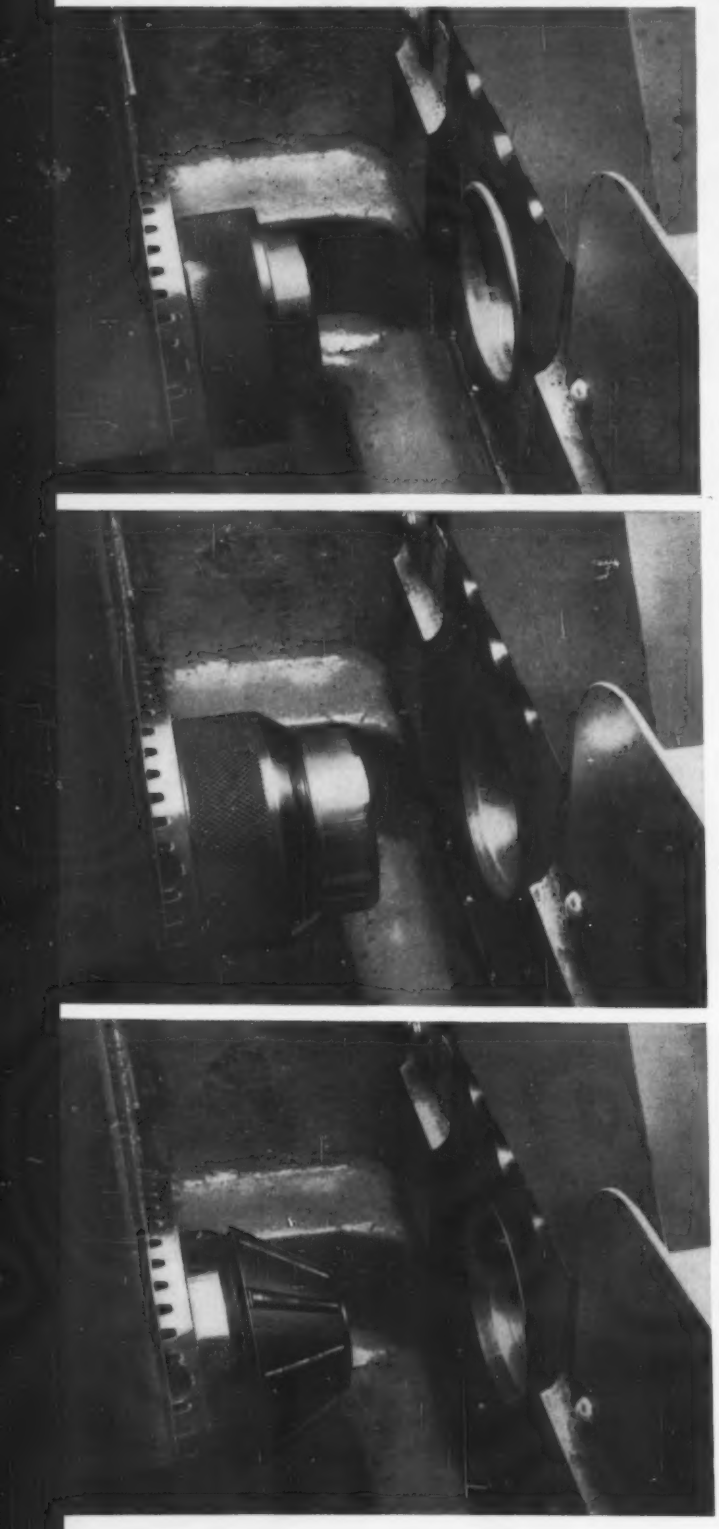


Fig. 5. This modified type of tube-forming machine is employed in producing a flare of double-wall thickness on the end of tubes.

Fig. 6. Photographs of the tools shown diagrammatically in Fig. 7, which perform the three operations necessary in double-flaring tube ends.



greater reduction is necessary, a series of operations must be performed in which progressively smaller mandrels are used. Actually, the mandrels in Fig. 2 are a set of three designed for progressive reducing.

Mandrels are also used in swaging the ends of tubular parts on the Etna rotary machine illustrated in Fig. 3. Tolerances as close as 0.002 inch are being met in wall thickness and diameters. Mandrels are employed because when conventional swaging was performed, an uncontrolled inner surface resulted that was rough and nonconcentric. Reaming of the tube was necessary in order to insert control rods. The reaming operation at times ruptured the thin wall and was often off center.

The polished mandrels conform to the hole size required in the finished part. For an operation, the mandrel is mounted on the extractor within the die itself or in the spindle of the machine. The nature of the swaging job determines which mounting should be used. The use of the mandrel eliminates the reaming operation and assures concentricity of both diameters. At the left in Fig. 4 are a considerable variety of parts swaged by this process, while mandrels used in swaging these parts are seen at the right.

As the machine spindle revolves in an operation, the hammers and die segments are thrown outward between opposing rollers by centrifugal force. Then, as the hammers pass under the rollers, they are forced against the die segments. These, in turn, are forced radially against the work in a series of very rapid, light blows. Each forging stroke results in a flow of material and a reduction in the cross-section of the tube being swaged. Most of the metal affected by the diameter reduction is moved lengthwise and lengthens the work. Some small portion of the affected metal is utilized in increasing the density of the metal. The operation is practically vibrationless because of the self-contained opposing blows.

Tubing with flared ends is widely used in aircraft construction. When the flared end is of single-wall thickness, it has been the experience of the Douglas Aircraft Co. that leaks sometimes develop as the tube is subjected to stress. For this reason the concern adopted a double-flared tubing end which provides a double wall thickness and an effective seal.

Special tooling had to be devised to form these double-flared tubes. They are formed in three separate operations. These operations are performed on a modified Vail tube-forming machine of which a closeup view is presented in Fig. 5. The tools used for the first operation are illustrated in the upper view of Fig. 6. This operation consists of curling back the end of the tube until it touches the outer wall of the tube as

seen at A in Fig. 7. From the two illustrations it will be obvious that the tube is securely gripped between split dies. The rotating, punch-like tool in Fig. 6 is simply advanced into the tube end until the curling is completed.

The second operation consists of flattening the curled end to form a tapered end having the required angle of flare. Correct diameters are also achieved in this step. As the punch-like tool seen at the left in the middle view of Fig. 6 enters the tube, the latter is permitted to slide lengthwise in the split dies a certain amount toward the approaching tool. Different dies are used in this operation from those in the first, as will be apparent from View B in Fig. 7.

The third and final operation consists of polishing or burnishing the inner surface of the flared end so as to obtain a finish that will insure a tight seal. This operation is performed with the tools shown in the bottom view of Fig. 6 and at C, Fig. 7.

Since the tools must be changed for the separate operations, it is the practice to run a quantity of parts through each operation before setting up for the next. In Fig. 5 the machine is arranged for burnishing. The sectional views in Fig. 8 show the appearance of the flared end after each operation. The fourth view shows a burnished completed end.

Substantial savings in cost have been attained through the adoption of this tube-flaring process. Tubes ranging from 1 to 4 inches in diameter and with wall thicknesses from 0.010 to 0.040 inch are being double-flared in regular production schedules. They are of stainless steel, either seamless or seam-welded.

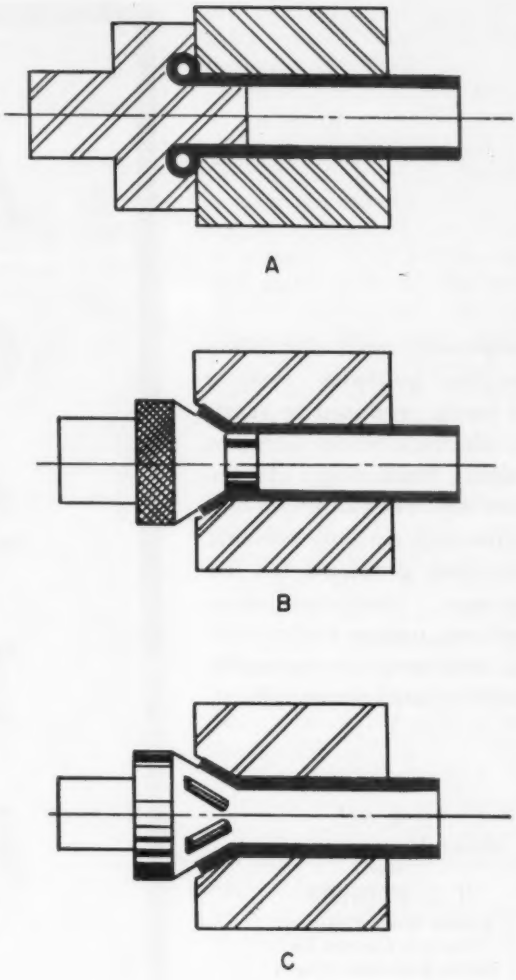


Fig. 7. (Above) Tools used in the successive steps followed in double-flaring the ends of tubes.

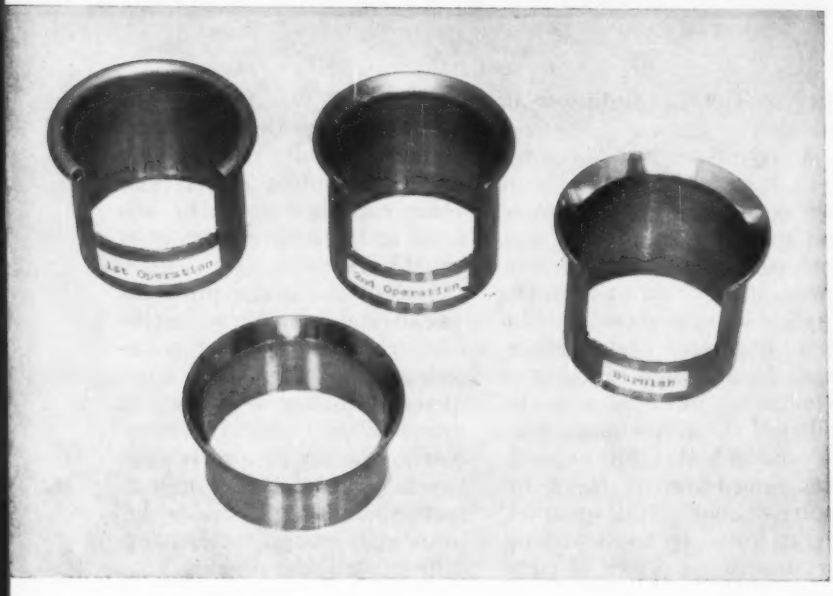


Fig. 8. (Left) The steps in forming double-flared ends of tubes are illustrated by the top three examples; the bottom example shows a burnished completed double-flared tube end.

MISSILE GUIDANCE SYSTEM Tooled for Production

Component parts for Nike-Hercules guidance systems are being produced in Western Electric's North Carolina Works. Machining of the many different aluminum and magnesium castings presents interesting problems for the engineer. Multiple-purpose machines, unique tooling set-ups, and template-controlled profiling are commonplace

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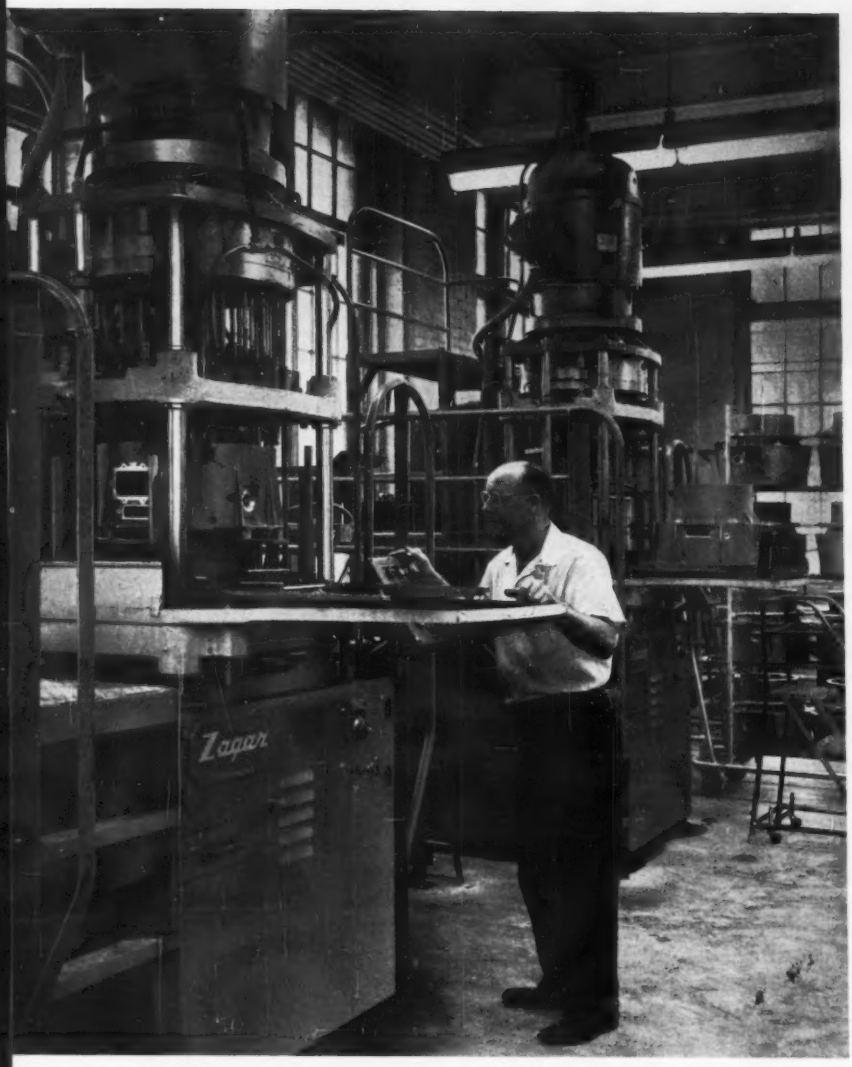
IT IS OFTEN SAID of the missile industry that its problems differ considerably from those encountered in other fields of manufacture—that mass-production methods are not adaptable to the fabrication of missile components. Yet, the manufacture of parts by means of various new processes and new developments in old ones is continually improving products and reducing costs. It is toward this end that the Greensboro, N. C., shops of the Western Electric Co., Inc., have been tooled to produce airborne portions of the guidance system for Nike-Hercules surface-to-air missiles.

A major portion of all component parts for this system start out as castings. Evaluation of the quantities needed against such controlling factors as floor space, time, costs, and various applicable methods indicated a definite pattern and, furthermore, an approach to the most economical procedures to be followed. One disclosure was, as expected, that full automation using transfer type equipment was out of the question, due to initial tooling costs and the present quantities of parts on order. It was found, however, that by designing machines to handle two or more different castings, greater machine capacities could be utilized and manufacturing costs could be reduced.

One of the major problems was to establish optimum methods for drilling, tapping, counterboring, and reaming large quantities of holes—on the order of 250,000 monthly. Fortunately, similarities existed between many of the associated parts, permitting them to be handled in groups, each having its own particular problem.



Twelve Castings Handled as One

Principal examples of this grouping technique are the die-cast aluminum-alloy module mounts that, when wired, form plug-in units in the Hercules airborne guidance system. They fall into twelve codes, each using the same basic casting but having its own special pattern with seven to thirty-three holes. This group of castings contains holes located from, and put into, five faces of the cube (that is, from the top and from each of the four sides). Illustrated in Fig. 1 are several of the modules having different hole groupings.

All twelve codes within the group are drilled on one special machine—the three-station shuttle type Zagar installation shown in Fig. 2. Although it has only three stations (two for working, one for loading and unloading), seven work-heads are brought into play. One module at a time is nested in the shuttle fixture *A* which travels from left to right and back on a pair of ground tubular rods. Except for air-actuated clamping fingers within the fixture to lock the casting in place, the machine functions hydraulically.

The first work station for the fixture is beneath the vertical multiple-spindle drill head *B* at the left. It drills all required holes in the top face of the casting. Drill heads *C* and *D* feed in horizontally to drill the back and front ends of the work-piece, respectively. A third horizontal drill head, hidden from view at the extreme left, takes care of that particular side of the casting.

When all tools have retracted, the shuttle fixture travels to the right and is positioned beneath the second vertical, multiple-spindle drill head *E*, as shown. Here, the holes previously drilled in the top face of the work-piece are tapped. Also, secondary operations are performed on the holes at the back end of the casting by a horizontal drill head *F*. Holes in the last of the five faces (right-hand face) are provided by the seventh working unit, horizontal drill head *G*. The fixture returns to a central position on the guide rails and is unloaded.

Change-over from one code of module casting to another is simplified by the use of universal drive-plates on the horizontal drill heads. Spindles protrude from the drive-plate in sufficient numbers and in proper locations to handle the hole patterns on all twelve casting variations. These spindles are numbered to aid in setting up only the drills intended to be used for a particular run. Spindles not required for the lot of castings being drilled are left empty.

An average module casting contains approximately twenty holes, of which seven would be drilled and tapped, seven drilled only, four drilled and countersunk, and two drilled, counterbored, and tapped—a total of thirty-five individual op-

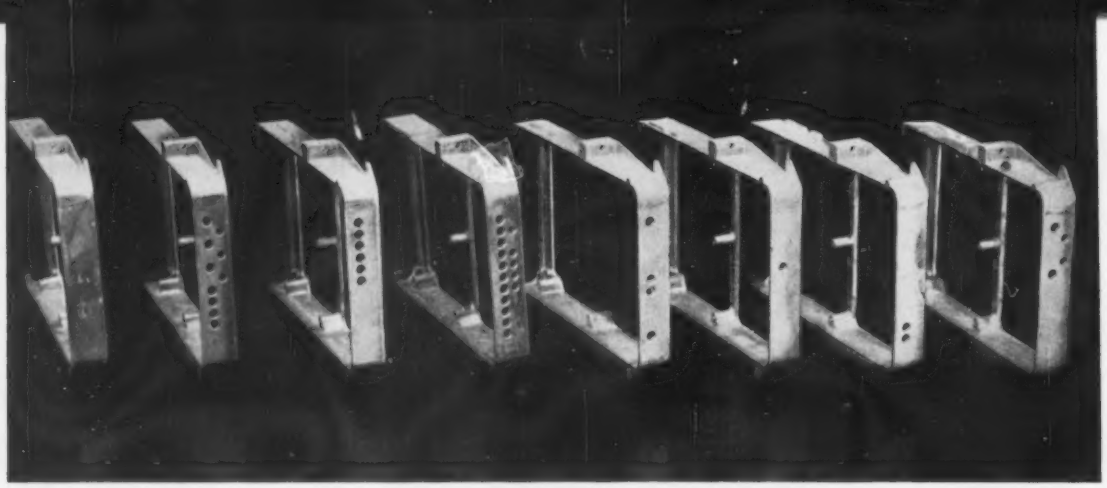


Fig. 1. Die-cast, aluminum-alloy module mounts form the base for plug-in units in the Hercules guidance system. Variations in hole patterns convert one basic casting into twelve different units.

erations completed in less than sixty seconds. It can be repeated that this type of tooling is possible because a number of parts of relatively the same size and shape (in this case, originally identical castings) were grouped and, in essence, treated as one. The reward is a saving of about 1100 hours per month as compared to the conventional tooling used to make preliminary production lots.

Same Machine, Same Tooling, Five Hole Patterns

Another striking example of component grouping to justify a machine tool of the type desired is the combining of castings that appear, on the surface, to be improbable, if not impossible. Two castings are involved and can be seen resting on a tray in front of a special, two-station Zagar machine in Fig. 3. The larger casting (right) is an aluminum heat exchanger that houses a series of plug-in modules. Four chambers direct air through the walls of the part to remove excess heat from the sealed assembly during flight of the missile. The smaller unit (left) is an aluminum amplifier-decoder casting that, when wired, plugs into the heat exchanger.

Tooling was kept relatively simple and changeover time was held to a minimum by using a combination fixture and sub-fixture, both locating on a common shuttle base. Two amplifier-decoder castings are accommodated by the top fixture, which can be installed or removed with ease. The main fixture for the heat-exchanger casting is permanently fixed to the shuttle base.

By carefully integrating a total of five hole patterns, the same tooling is used to drill two sides of the smaller part and three sides of the larger part. In Fig. 3, two amplifier-decoder castings are shown mounted on the removable fixture and positioned beneath the multiple-spindle drill head. At this station all the holes shown at A in Fig. 4 are drilled. The fixture is then shuttled to a position beneath the second multiple-spindle

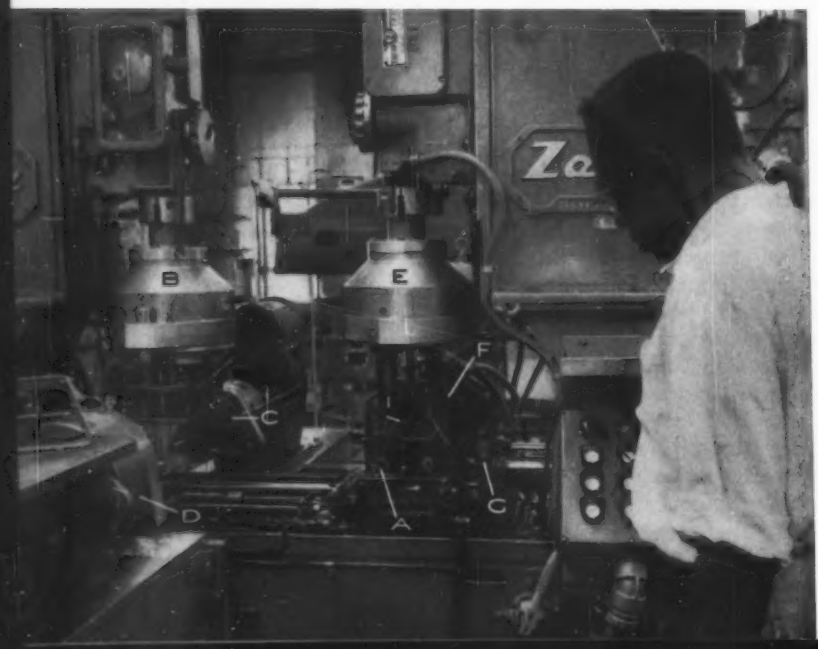


Fig. 2. Three-station drilling and tapping machine handles all twelve hole patterns in the basic module-mount casting (see Fig. 1). Five horizontal and two vertical work-heads are brought into play at two of the stations.

head, Fig. 5, where the required holes are tapped. Positive alignment between the holes and the taps is assured by a locating pin *H* that enters a bushing in an upright member *J* of the fixture frame as the head descends.

When the operation is completed, the parts are removed, turned over in a sidewise direction, and replaced on the fixture. The same sequence is repeated to drill and tap the holes in the opposite face as indicated at B in Fig. 4. Hole patterns are so laid out that those tools not required for a particular operation do not contact the work-piece, but cut air.

To handle a run of heat-exchanger castings the upper fixture is removed. One work-piece at a time can be loaded flat on the main shuttle fixture. With the fixture at the left-hand side of the machine, the thirty-eight holes shown at C are drilled. They are then tapped when the fixture is shifted to the right-hand side of the machine below the second multiple-spindle head.

As was the case with the amplifier-decoder castings, the heat exchangers are flipped over 180 degrees and reloaded on the fixture. A second index is made between the two work-heads, and the fourteen holes shown at D in Fig. 4 are drilled and tapped. Again the castings are removed from the fixture, but this time they are only turned 90 degrees and reloaded with their two outboard legs in the down position. Three holes are drilled and tapped in this edge of the work-piece as shown at E.

Using this one machine, and without altering the tooling (except for adding or removing the sub-fixture), forty-five holes are drilled and tapped in the heat-exchanger casting and sixty-six holes in the amplifier-decoder casting, for a total of 222 operations if done one at a time. This represents a saving of 840 hours per month over the time required with prototype tooling.

Machining the Main Guidance Housing

A majority of the electronic sub-assemblies for the command-control system are contained within a large main guidance housing. It is a no-draft sand casting of K1A magnesium. The alloy has an exceptional damping capacity, and it is this high resistance to vibration that makes it especially suitable for missile-guidance applications. It is of interest to note that the wall thickness throughout most of the casting body is only 3/16 inch.

Preliminary operations consist of machining the necessary reference surfaces and pads and drilling a central hole on a King vertical boring mill for locating in subsequent steps. From there the castings are transferred to a trunnion type fixture on a Carlton radial drilling machine, Fig. 6, where key locating holes are drilled and reamed. Outboard spoke type handles on the fixture facilitate rotation through 180 degrees for loading and unloading.

In another setup on a 40-inch King vertical boring mill, Fig. 7, the large (bottom) end of the main guidance housing is faced and the inside of the rim is bored. Brazed carbide tools are run at a surface speed of 600 fpm (feet per minute) and a feed of 0.005 ipr (inch per revolution). During follow-up operations on a similar machine the small (top) end of the casting is faced and bored, outside mounting pads are finish-turned, and internal ring grooves are cut into both the upper and lower rims. To prevent chatter marks on the finished surfaces, three sausage-shaped sand bags are wrapped around the inside

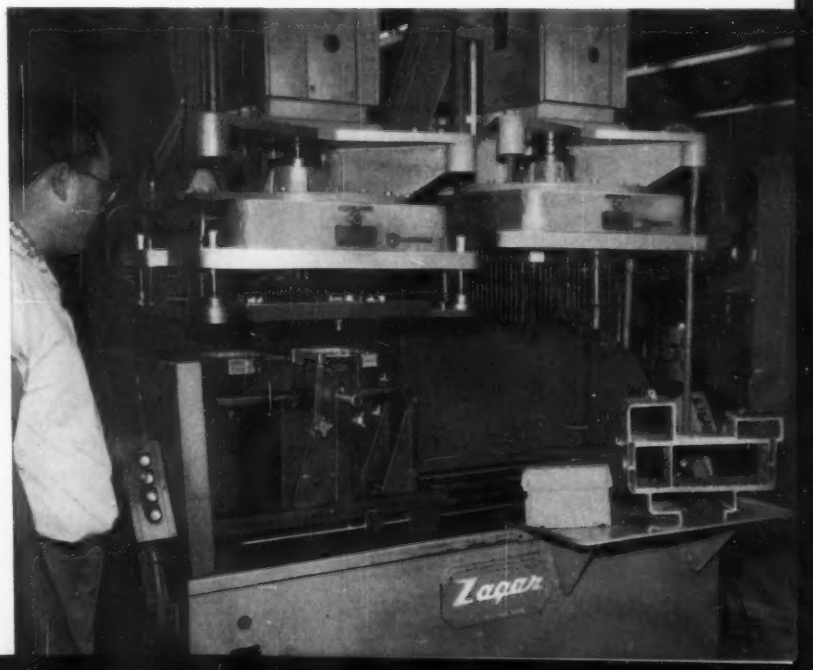


Fig. 3. Two castings of different size and shape (right, foreground) are drilled and tapped on this two-station machine without changing the tooling. Combination fixture and sub-fixture are carried on a shuttle.

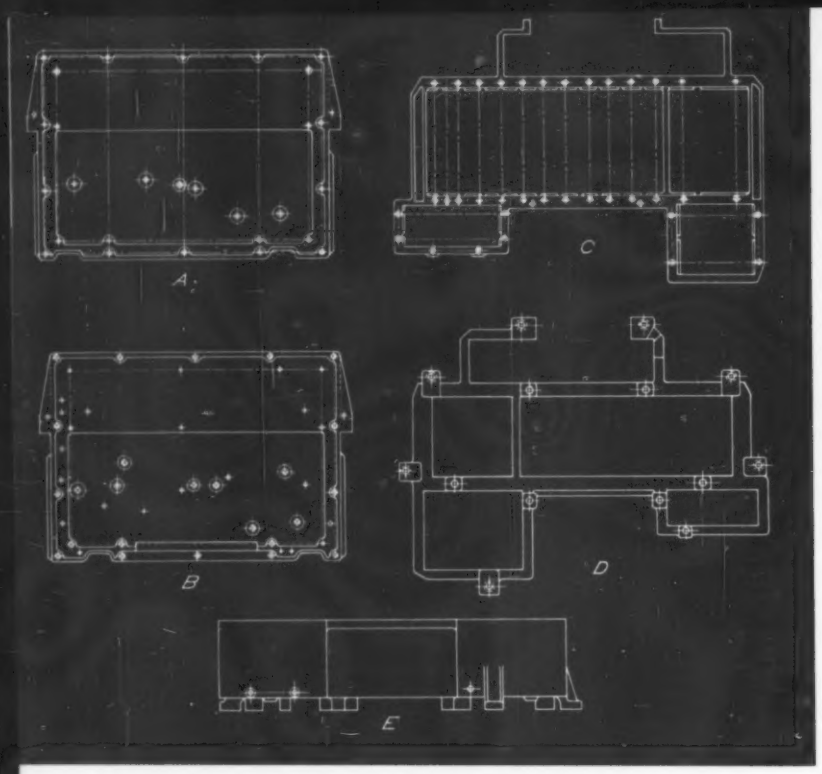


Fig. 4. Tooling on the two-station machine in Fig. 3 integrates five hole patterns to drill two sides of the amplifier-decoder casting (Views A and B) and three sides of the heat-exchanger casting (Views C, D, and E).

of the casting during machining. One of these is partially visible through an opening in the wall of the illustrated work-piece.

Five areas for access and mounting purposes are machined around the periphery of the casting in the setup shown in Fig. 8. The machine is a Gorton Trace-Master that has been somewhat modified for this application. One of these modifications is a large block between the machine frame and head to increase the over-all working height. Forward travel of the head has been increased by the use of a special horizontal ram designed with extended length.

An unusual rotating fixture, resembling a barrel lying on its side, is locked to the machine table. Pins around the fixture flange assure that the casting will be properly oriented. This is important because area templates ring the right-hand end of the fixture and must be aligned with their respective sections of the housing periphery.

Carried on an outrigger extending from the right-hand side of the horizontal ram is a True-Trace hydraulic tracing head. Its stylus follows the small template to accurately complete the openings and surfaces required. Quick-change tooling is used and operated at a speed of 4000

Fig. 5. Two amplifier-decoder castings held on a removable sub-fixture are positioned beneath the tapping head of the machine shown in Fig. 3. Locating pin (H) engages a bushing in member (J) for positive alignment.

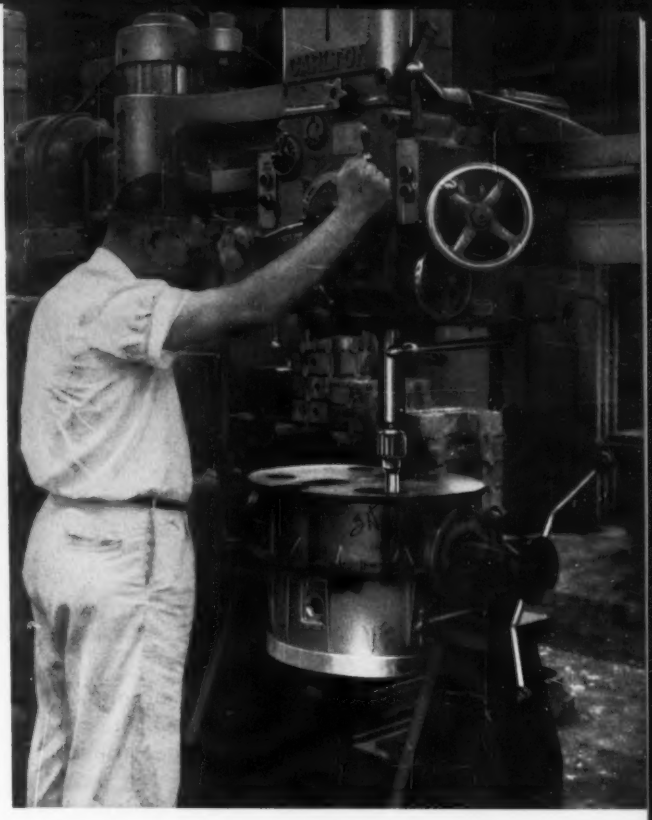


Fig. 6. After machining reference surfaces and pads on cast-aluminum housings, they are brought to this radial drilling machine. While mounted on a trunnion type fixture, key locating holes are drilled and reamed.

rpm, a feed ranging from 12 to 14 ipm, while taking a 3/16-inch depth of cut. After all surfaces in one particular area are finished, the fixture is unclamped, a locating pin is removed, and it is then rotated to a new position. When the locating pin is again plunged home, the next area on the periphery of the guidance housing is directly below the cutter, and the appropriate template is directly below the stylus. This is repeated until all five areas have been finished.

Numerous mounting surfaces within the large end of the casting must also be contour-machined. This is done on another Gorton Trace-Master machine, Fig. 9, that has been modified in the same way as the first. The internal mounting surfaces are situated on five different levels. Positioning of the tool at each level is hydraulically controlled by an eight-position turret actuated from the front of the machine. Many of the surfaces finished in this operation are denoted by shading in Fig. 10.

Two circular templates are used to guide the cutter. The one illustrated, which is the second template to be used, is slipped over pins on a tall pedestal beneath the tracing head. The first template used in the operation is placed over this one, locating on the same pins.

A long, end-mill type cutter is being used. For rigidity, the mild-steel shank contains a 3/4-inch-diameter core of solid carbide. On the end of the cutter is a single, triangular-shaped throw-away insert of Grade K6 Kennametal. The edge of the cutter end opposite the insert is cut back to maintain proper balance. Smaller tools are used in some of the tighter corners, and these are made of solid carbide. As in the previous profiling operation, a 3/16-inch depth of cut is taken at a speed of 4000 rpm, but with a feed ranging from 8 to 14 ipm. The feed rate can be quickly changed by the operator by a lever-actuated control valve located at about 6 inches above the stylus.

One of the more difficult operations was that of drilling the main housing. Many variables existed in each of these castings—their relative size-

Fig. 7. The bottom (large) end of the main guidance housing is faced, and the rim is bored at a speed of 600 fpm on this 40-inch vertical boring mill. Similar operations are later performed on the opposite end of the casting.

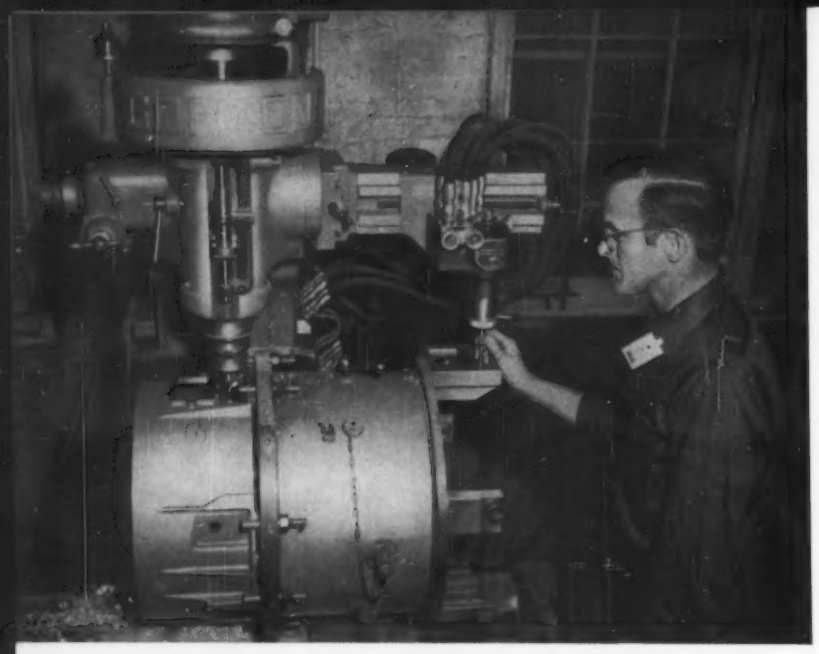


Fig. 8. Five peripheral access and mounting areas are profiled on this tracer-controlled vertical milling machine. The same number of templates extend from the end of the fixture and rotate with it.

to-section ratio was greatly out of proportion, with the side walls as thin as 1/8 inch, with no draft. Shrinkage variances, core shifts, mold mismatch, etc., represented some of the problems that had to be compensated for in designing flexible tooling.

Two Zagar machines were especially designed and built, one for drilling all the holes in the larger end of the casting, and one for drilling all the holes in the smaller end and around the outside step surface. In Fig. 11 can be seen the first of the two heads. The work-piece is seated in a holding fixture that travels on rails. It is then advanced manually against a stop that positions the work-piece accurately beneath this multiple-spindle drill head.

At the command of the operator, the platen supporting the fixture and rails is raised hydraulically, feeding the work into the rotating drills. Thirty-four spindles are carried by this drill head, including four 1 1/2-inch-diameter reamers having inserted carbide blades. All tools used on the small end of the casting rotate at 700 rpm.

The same rail-mounted type fixturing is used at the second installation. Here (heading illustration) sixty holes are drilled in the large-diameter end of the guidance housing when the platen is raised. Hole patterns on the two ends of these castings are identical to those on an instrument mounting plate, thus adding to the flexibility of the tooling.

After a run of castings has been drilled, the two machines are changed over for tapping. The machines are linked together at the rear by a roller storage conveyor. A branch of this conveyor leads into the work area beneath each drill head to facilitate the change-over. By loosening eight mounting bolts the drill head can be removed.

A support cage is positioned beneath the head and raised up to it prior to removal. When the head is released, the platen is lowered and the support cage is rolled onto the storage conveyor. A tapping head is then rolled from the storage conveyor to the work area, is elevated into position, and secured in place. Two men can complete the change-over on both machines in one and one-half hours.

Main-housing castings are rerun through the two installations to tap the required holes on each end. The head on one of the machines taps several pitches of screw threads simultaneously. To do this, each tap is driven by its own lead-screw. Cost studies have revealed large savings over prototype tooling—approximately 1875 production hours per month. When all machining has been completed, each casting undergoes an internal pressure test at 20 psi to check air seals for leakage. No moist atmosphere must pass the seals and enter the guidance housing after launching.

Some Tooling and Techniques in the Precision Gear Shop

To maintain scheduled production of Hercules guidance systems, an engineering department was organized to set up a precision gear shop in the company's North Carolina Works. Three basic problems were involved. First, to meet the demands of modern instrument work, quality levels had to be high. Second, short delivery schedules would have to be met. Third, quantities involved would be low, therefore costs would be difficult to hold at a reasonable level.

Fig. 9. A machine similar to that shown in Fig. 8 is used to contour numerous mounting surfaces within the casting. Circular templates rest on a pedestal beneath the stylus to control the operation.

Statistical quality control plays an important part in gear-shop operations. Machine, tool, and gage capabilities are tested with control charts. Certain dimensions and tolerance ranges are charted each time a particular work-piece is run.

Short-interval delivery and minimum cost on small quantities are, together, based on a system of general-use tooling. An example is the manufacture of flat gear blanks. Such blanks of aluminum, that are 1/16 to 1/2 inch thick, are produced on commercial washer punch and dies. The bore is punched undersize and the outside diameter oversize to allow for finish-machining.

Larger flat aluminum blanks requiring more than 35 tons to produce, or measuring more than 4 inches in diameter, are first sheared square, after which an undersize hole is punched in the center. The work-piece is locked in a rotating fixture and the outside diameter is cut oversize on a DoALL band-sawing machine. One punch and

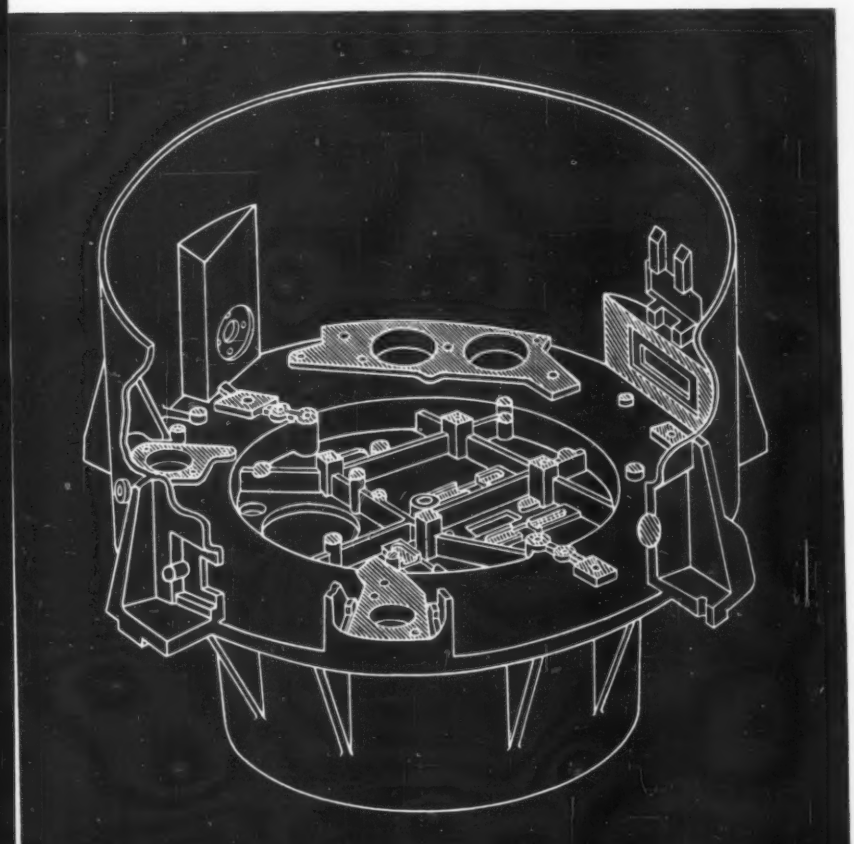
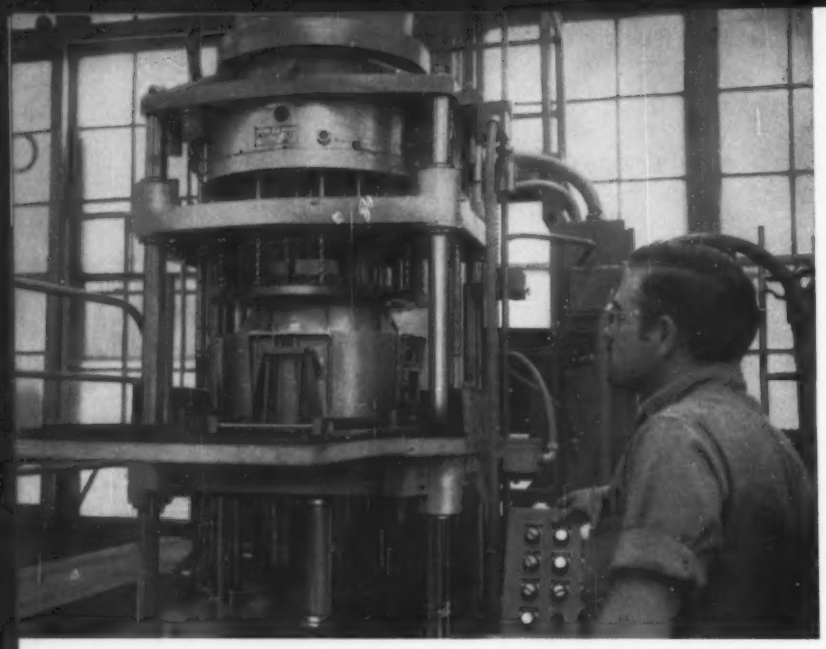
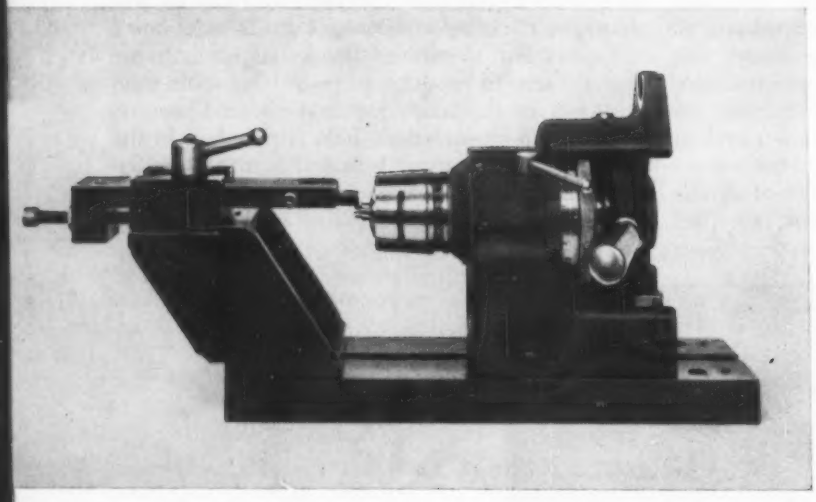


Fig. 10. Cut-away view of the guidance housing casting showing the internal mounting surfaces. Some of the surfaces that have been machined in the setup in Fig. 9 are indicated by shading.





die and one sawing fixture are used for any size of blank from 4 to 12 inches in diameter. Oval holes for anti-backlash springs (when required) are punched on a die set equipped with interchangeable punches and dies. Center distance between the holes is adjustable to accommodate gears of different sizes.

If the gear diameter exceeds 5 inches, lightening holes are drilled and the faces are rough-ground on a Gardner horizontal double-disc grinder to remove the skin. They are stabilized at room temperature for twenty-four hours, after which the faces are finish-ground.

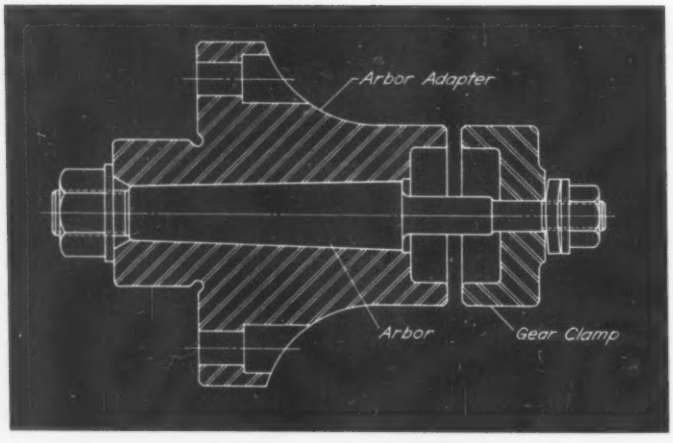
Several drill jigs have been developed for special jobs, yet are versatile in their scope. One drill jig, Fig. 12, is designed around a commercial Hardinge indexing fixture to drill pilot holes and drill and tap a set-screw hole in gear hubs. Having two dozen adapters, this tool handles more than 300 combinations of hub, pilot-hole, and tapped-hole sizes.

Four different types and sizes of gear-cutting machines are being used. In the interest of tooling simplification, a series of adapters was designed to be interchangeable between all machines within the size limitations of each. A typical adapter assembly is shown in Fig. 13.

Fig. 11. (Top) One station of a two-unit installation for drilling and tapping the guidance housings. Here, the work is elevated to the multiple-spindle head to drill the small-diameter end.

Fig. 12. (Center) One of several drill jigs developed in the precision gear shop. Designed around a commercial indexing fixture, it will handle 300 combinations of hub, pilot, and tapped holes.

Fig. 13. (Right) This adapter assembly is one of a series that is interchangeable between four different types and sizes of gear-cutting machines. By selecting the appropriate adapter and arbor, the fixture can be assembled in minutes.



Each adapter has front and back surfaces that are parallel within 0.0001 inch total indicator reading, and a tapered bore that is square with these surfaces. The arbor has one ground diameter that locates within the gear bore and one ground tapered diameter that seats in the adapter. By selecting an adapter with an outside diameter slightly smaller than the root diameter of the gear to be cut, and an arbor to fit the bore of the gear, a cutting fixture that matches the requirements of any ordinary gear can be assembled in minutes. This fixture is then mounted on the face of the machine spindle and indicated to run true, independently of machine runout.

An efficient, company-built deburring tool is shown being used on a Barber-Colman No. 3 gear-hobbing machine in Fig. 14. Supported by the machine's over-arm, the deburring tool has a carbide disc *K* that bears against the periphery of the gear while it is being cut. The face of the carbide disc is formed with serrations that are spaced 0.020 inch apart and at an angle of 45 degrees to the tooth crest. It is backed up by light spring pressure. A carbide insert *L*, brazed to a tool-holder, rests against the back of the gear teeth, also under light spring pressure. As the work-spindle rotates, any burrs that might be raised by the hob on either of these two surfaces are quickly removed.

Precision aluminum high-pitch gears are checked for accuracy in the manufacturing area. The shop is not temperature-controlled, so another means must be employed to assure constant and accurate readings. Diameters are checked over wires to a total reading of 0.0005 inch in an American Instrument Co. constant-temperature oil bath, Fig. 15. Electric heating elements are set to maintain the bath at a temperature of 80 degrees F.—readings being corrected by chart to 68 degrees F.

Oil in the unit is exceptionally clear, giving the impression (in the illustration) that the tank is empty. Actually, the base of the P & W Supermicrometer is submerged. Racks beneath the circulating oil are loaded with gears prior to checking. Aluminum gears stabilize sufficiently for measuring after five minutes of submersion. Gage-blocks are kept in the bath twenty-four hours before being used.

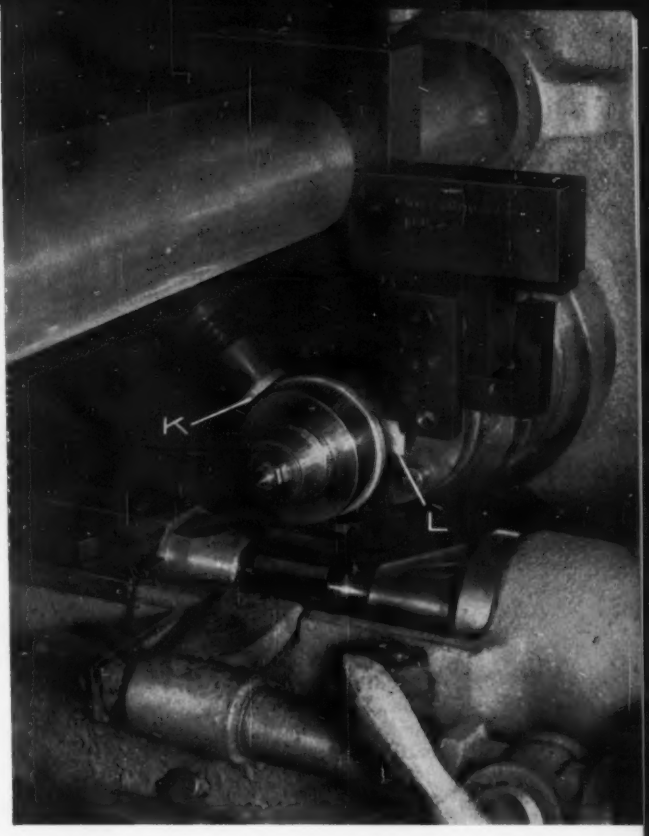
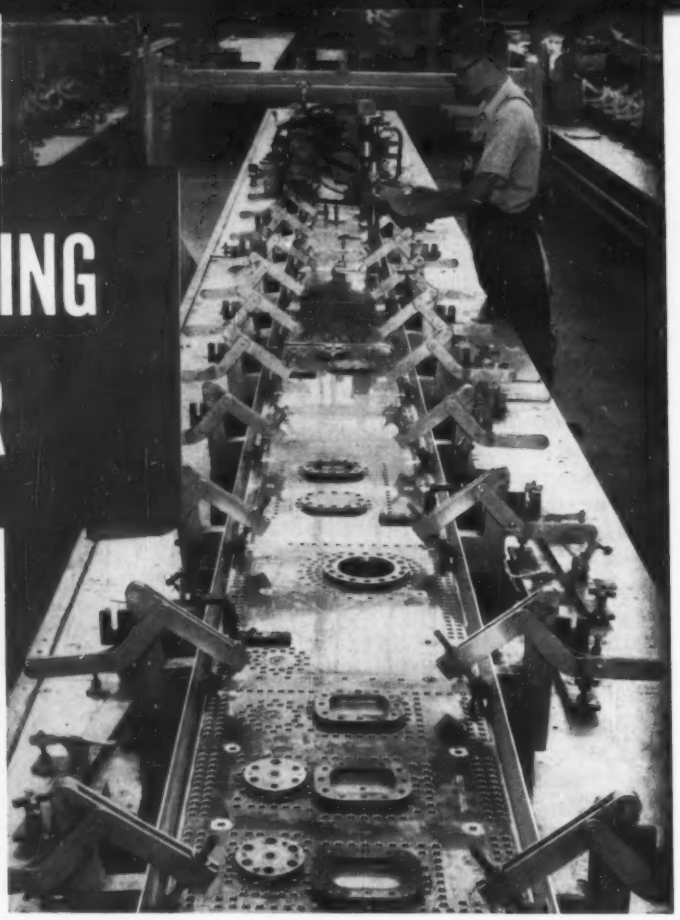


Fig. 14. (Above) Efficient shop-built deburring tool mounted on a gear-hobbing machine. During the operation, a serrated carbide disc (K) contacts the periphery of the gear, while a carbide insert (L) contacts the back of the gear. Both are under light spring pressure.

Fig. 15. (Right) Checking precision fine-pitch aluminum gears over wires. To maintain uniform conditions at all times, the inspection is carried out in a constant-temperature oil bath at 80 degrees F. Readings are corrected to 68 degrees F.

JET-AGE DRILLING AT CONVAIR



THOMAS W. DRIVER
Plant-Engineering Department
Convair, San Diego, Calif.
A Division of
General Dynamics Corporation

THE DEMANDS of today's world transport systems for equipment capable of moving people and goods in the shortest possible time from place to place have resulted in the designing of aircraft to fly higher, faster, more economically, and with larger pay loads. Convair, San Diego, Calif., a division of General Dynamics Corporation, anticipated some time ago that their 880 jet airliners would place nearly insurmountable demands on manufacturing facilities using the techniques and tools that produced the aircraft of yesterday. With this in mind, design engineers and production men pooled their resources of talent and know-how to design and build new families of production tools. This effort has resulted in the application of unique methods and tools which are satisfying the requirements of closer tolerances, better quality control, and manufacturing costs within program budgets.

Typical of this breakthrough of a major manufacturing barrier are special Convair-designed and built wing-spar gantry drills and other drilling equipment. These new machines present a remarkable contrast to the days when hordes of workers swarmed over aircraft bucks and jibs with hand-operated tools. The new equipment rapidly produces the most intricate wing structures in the commercial aircraft field.

Wing spars for the Convair 880 jet transport are machined from long aluminum billets on a 90-foot spar mill to closely held tolerances. Six of these spars, which comprise a ship set, became the key part in a sub-assembly operation before going to major wing assembly. Faying surfaces of the sub-assembly must be coated with Scotchweld, a sealant, to insure sufficient tightness of the wing joints so that the wings may serve as fuel tanks in addition to their customary function. The wings are later heat-cured in a special oven to complete the sealing process. In the uncured state the Scotchweld-covered surfaces must be protected from contaminating materials.

The wing-spar sub-assembly requires the drilling of approximately 38,000 holes in each ship set and the riveting or bolting of 1368 parts. Accurate hole location, with a maximum tolerance of 0.002 inch on the diameter of at least 30 per cent of these holes, demanded drill fixtures incorporating a high order of rigidity and accuracy. Of paramount importance was the necessity of a drill-fixture design which would permit easy loading and unloading of the separate parts contained on the sub-assembly.

Another consideration was that the drilling, assembling, and riveting operations had to dovetail smoothly into a tight production schedule.

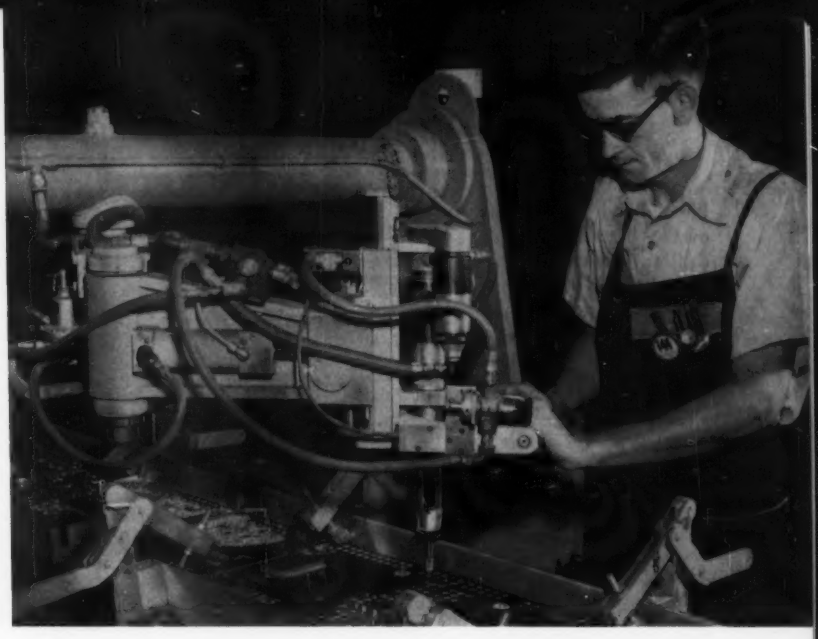


Fig. 1. The pneumatic drilling unit provided on machines of the type shown in the heading illustration, and for circular fixtures used for fuselage pressure bulkheads.

This required that operator fatigue be given prime consideration in the selection and location of operating controls. The solution to the many problems was found in a tooling concept which was carried through the design, fabrication, and installation phases by a joint effort of the tooling and plant-engineering departments.

For each wing-spar sub-assembly, a horizontal drill-fixture table 70 feet long was constructed, as shown in the heading illustration. After the sub-assembly is placed on this table, templates made of 3/16-inch-thick aluminum plate are laid on the work as shown and clamped in place. The templates are provided with countersunk holes for the purpose of establishing hole locations. Pull-pin locators and quick-action clamps hold parts and templates accurately in place. On each side of the drill-fixture tables there is a 2 1/2-inch-diameter, hardened, ground, and polished steel rail. Mounted on these rails are gantry-like drilling machines that travel the full length of the table. The drilling unit is provided with Thomson linear recirculating ball bearings for easy movement by hand.

The drilling machine is equipped with a Quackenbush power-fed, pneumatic drill, which is mounted on the end of a double-jointed articulating arm, as seen in Fig. 1. A Sheridan adapter is provided in which is assembled a combination pressure-foot and non-rotating drill bushing. Actuation of a pneumatic cylinder geared to a rack causes a dovetail slide to feed the entire drill assembly downward until the drill bushing enters a hole in the template. A pressure of 175 psi is applied to the bushing through an air cylinder to clamp the several parts together during drilling.

The pneumatic drill is mounted on a quick-acting, long travel slide which, in turn, is mounted on the dovetail or pressure slide. The quick-acting slide, operated by a hand crank, provides setup adjustment and sufficient vertical positioning to allow the drill head to clear obstructions encountered in moving the drill over the assembly. The quick-acting slide, when adjusted to drilling height, is locked in place by means of an air-cylinder-operated device which is actuated by a push-pull valve.

Also mounted on the front of the machine is a cylindrical handle used by the operator to guide the drill. A slight rotation of this handle away from the operator serves to close a small poppet air valve in the handle. This valve operates a "Meadmatic" air valve to energize the cylinder which drives the pressure slide and drill down into drilling position. Operation of a thumb lever actuates the power feed of the pneumatic drill. Release of the thumb lever causes the drill to retract quickly. A slight rotation of the handle toward the operator reverses the direction of the pressure-slide cylinder and causes it to raise the drill assembly for moving the drill head to the next template guide hole. One air-pressure regulator can be set to adjust the force of the drill bushing on the template. Another regulator is used to adjust the down speed of the drill assembly to insure the operator's having time to guide the bushing into the template holes.

The gantry drill assembly weighs more than a thousand pounds, yet it can easily be pushed along the tracks by a single operator due to the use of the polished steel rails and the recirculating ball bearings. During the actual drilling operations, the gantry is firmly locked in place by two pneumatically operated brake-shoes.

The double-jointed articulating arm is made of aluminum castings equipped with Timken adjustable-cone tapered roller bearings. Lifetime lubrication is provided by pre-packing the bear-

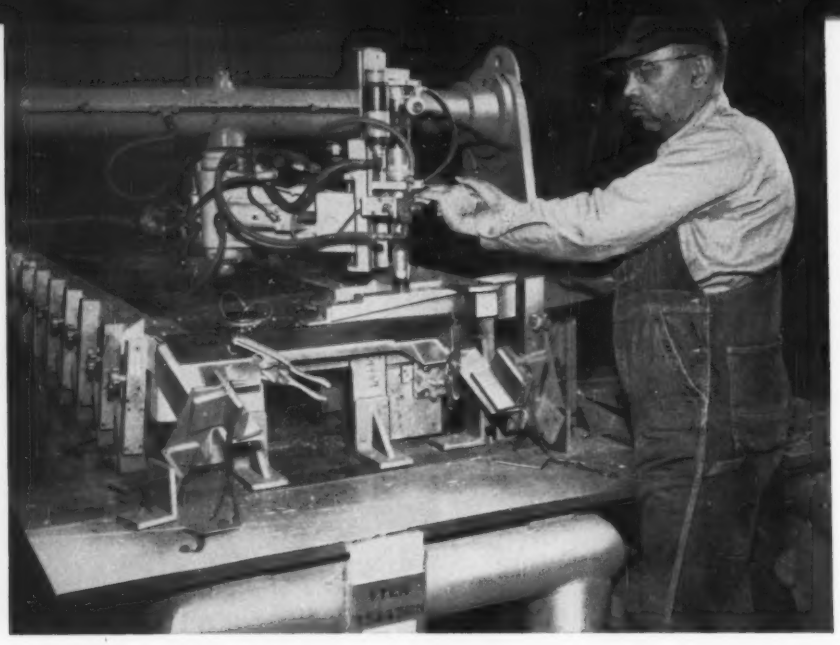


Fig. 2. End view of one of the fixtures used for drilling the holes required in a wing-spar sub-assembly. Clamping arrangement on this particular machine can be seen at the left.

ings with Lubriplate and installing oil seals. The arm castings rotate on hardened and ground tool-steel pivot shafts. Rigidity is such that, although the drilling assembly is suspended over 3 feet from its pivoting support, holes can be drilled well within the close angularity tolerances.

To eliminate "reaming" of the holes, a pilot has been incorporated on the drill. A short length of the tip is ground a few thousandths under size and so a hole is rough- and finish-drilled in one operation. The required finish is obtained by using a high-spiral, double-margin, high-speed steel drill.

Six of these gantry drills have been installed. Production time has been reduced from 320 hours to 180 hours per ship set of wing spars. On some of the drill-fixture tables, the work and templates are clamped as shown in the heading illustration. Other tables are equipped with swinging clamps, as seen in Fig. 2.

The fuselage pressure bulkhead of the Convair 880, designed to allow pressurization of the aircraft for safe, comfortable flight at high altitudes, consists of approximately fifty parts, including twelve minor forgings and two large, 80-pound parts that are machined from the solid. The two 80-pound shapes are valued at $5000 each when they reach the bulkhead assembly stage and it is, therefore, imperative that they should not be drilled defectively at this stage of manufacture.

Assembly of the bulkheads requires the drilling of 1669 holes that vary in diameter from 3/16 to 3/8 inch. Most of these holes are drilled through two to five parts at one time. Then rivets or Huckbolts are inserted to fasten the assembly together. On 158 of the holes a tolerance of 0.002 inch is specified, while ninety-four holes are drilled to 0.003 inch. The thickness of the metal drilled through varies from 3/16 inch to 1 1/8 inches.

Convair tool engineers developed the 14-foot-diameter horizontal fixture shown in Figs. 3 and 4 for the complete drilling and assembly of this bulkhead. Pull-pin locators and De-Sta-Co quick-acting clamps are used to accurately position the

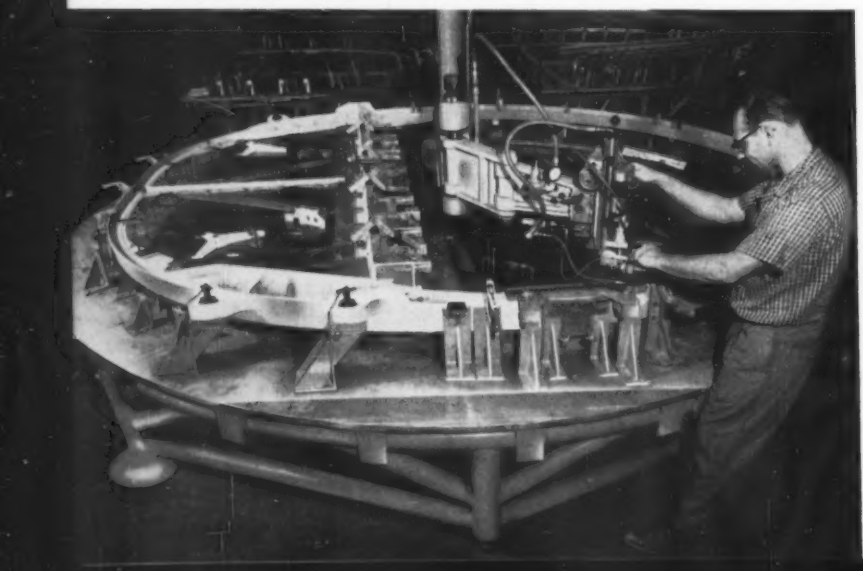


Fig. 3. Fuselage pressure bulkheads ranging up to 14 feet in diameter can be handled with the horizontal drilling fixture here illustrated.

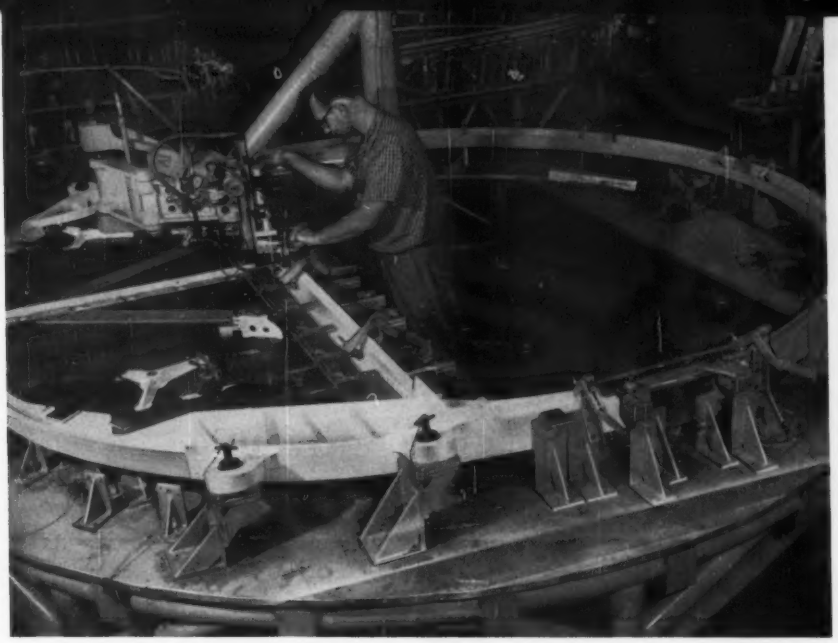


Fig. 4. A total of 1669 holes is drilled in the bulkhead components with the operator standing outside or inside of the fixture, or kneeling on top of the unit.

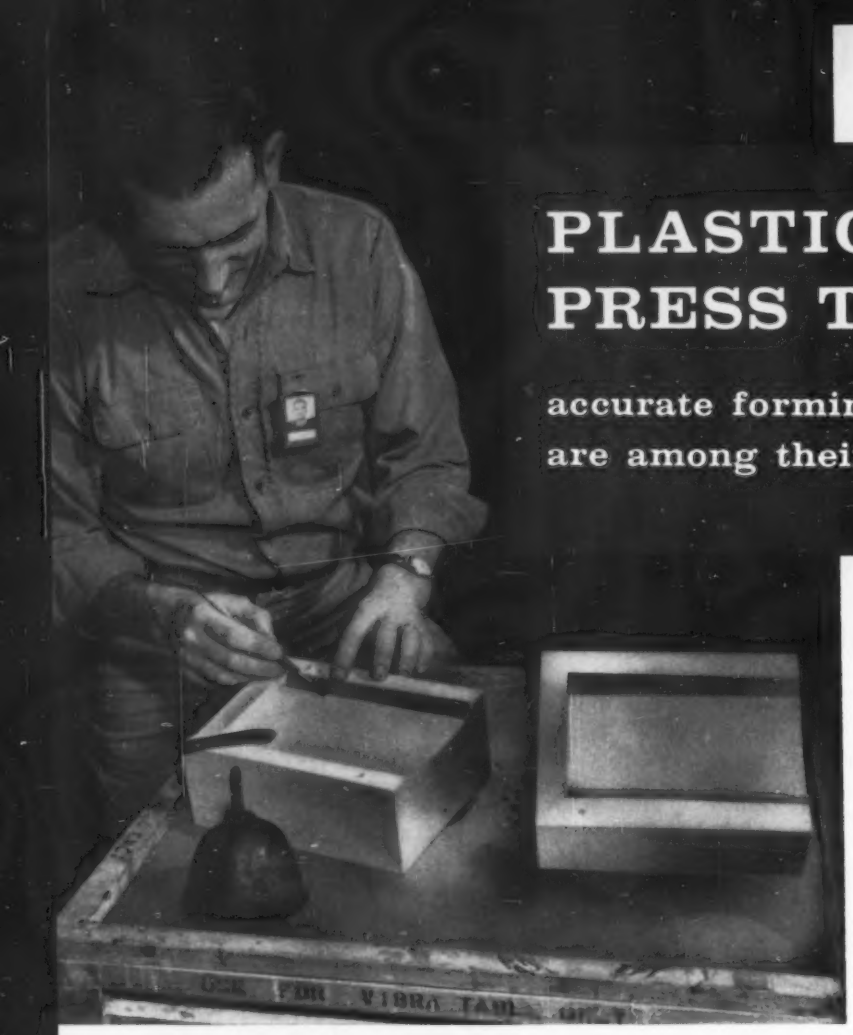
various components for drilling. Hole locations are established by simple removable templates in which drilled, countersunk, and reamed holes provide for accurately positioning a drill bushing mounted on the drilling unit. It will be noted that the operator can conveniently run this unit from either the outside or inside of the fixture. Or he may kneel on top, as seen in Fig. 5.

It is necessary to drill 1669 holes in this assembly. For this operation the fixture was constructed with a rigid column in the center. Attached to this column is a double-jointed articulating arm with a pneumatic drilling head. There can be no deflection of the drilling unit over the 7-foot span from the center to the periphery of the table; the equipment had to be so designed that the drilling unit could be easily moved and guided with one hand. The drill is quickly adjustable for height and, in drilling position, is locked in place. In addition to a power feed the drill can be fed manually. As in the case of the machine previously described, there is a guide bushing on the drilling unit for insertion in the template holes. Pressure is exerted by the bushing on templates and parts to positively eliminate any shifting during drilling. Operation of the drilling unit is the same as that on the wing-spar fixtures. Obviously, the unit can be swung through 360 degrees. The designer settled on entirely pneumatic-powered components for the drilling machine.

Shop air is piped up through the central column for driving the drill spindle. At the top of the column there is a Chiksan revolving coupling which supplies air to the piping of the radial arm. Flexible hoses are used at the articulating joints.

All 1669 holes are now drilled within eight man-hours, whereas thirty-two man-hours were required prior to the installation of this machine.

Fig. 5. Drilling unit of the bulkhead fixture is mounted on end of an articulating arm for convenient application around the fixture.



PLASTIC-FACED PRESS TOOLS . . .

accurate forming and long life are among their attributes

RAYMOND H. SPIOTTA
Associate Editor

ATTAINMENT of product accuracy and extension of tool life are, together, subjects of discussion and engineering effort whenever problems of close-tolerance machining arise. This is most often the situation during the manufacture of parts from-the-solid, such as bar stock, castings, forgings, extrusions, etc.

Precision machining has always been closely associated with the production of reciprocating aircraft engines. However, now that turbojet engines are not only replacing their piston type counterparts as the prime power plants for the military air arm, but also making huge inroads in civilian aviation, precision and tool life are receiving more and more attention in the press-working field. Engineers at Pratt & Whitney Aircraft in East Hartford, Conn., have taken substantial strides in this direction.

Internal Forming with Steel-Cored Plastic Mandrels

Plastic-facing is the key to the advanced press-tool designs now being used. Remarkable results have been obtained in the forming of sheet-metal parts for jet-engines, a typical group of which is displayed in Fig. 1.

From this illustration it can be seen that both internal and external tools are involved. For example, the skin shown at *A* is for a turbine exhaust strut and is made of stainless steel. Manufacturing steps include stamping and flanging, after which the skins are folded and given a preliminary airfoil contour. Up to this point the procedure may be considered to be conventional.

Final airfoil shape is obtained, logically, by restriking. A steel mandrel was made up and inserted into the preformed part for this operation. Results were not good—the airfoil contour did not adhere to blueprint dimensions. Although the mandrel was redesigned several times, the restruck skins were still not entirely satisfactory and rejects were high.

Considerable development was necessary in an effort to compensate for spring-back when using a steel mandrel. Variations in material thickness and specifications left much to be desired in the finished product.

Solid steel mandrels were replaced by those constructed with resilient plastic or other syn-

thetic materials. The dies are now cut to basic blueprint dimensions. One of the new mandrels can be seen at the top in Fig. 2. Below it are shown the three final steps in producing a turbine exhaust strut: left, skin after folding and preforming; center, skin after restriking to desired contour; right, completed strut after internal stiffeners and end caps have been assembled and welded, and after the trailing edge has been closed by welding. It should be pointed out that the illustrated mandrel is not solid plastic, but consists of a reinforced plastic jacket enveloping a steel or aluminum core.

There are five basic stages in the making of a plastic mandrel. The first is to make an accurate master model of the part. Making a "reverse" of the master model is the second stage. This is done by first boxing-in the master, then pouring either plaster or a plastic material around it. Plastic is used most frequently. The "reverse" is actually a split mold containing integral metal bushings for locating purposes and for locking up the two halves.

Some hand work must now be done in the mold cavity. This operation is termed "waxing-in," and is shown being performed in the heading illustration. In this process, thin strips of sheet wax (the thickness of the metal to be formed) are placed along those areas of the cavity representing the leading and trailing edges of the turbine exhaust strut. The wax is flush with the parting surface of the mold and extends back into the cavity a distance of approximately 3/4 inch.

A word on the purpose of waxing-in. The master from which the "reverse" was made is shaped to dimensions representing the outside surfaces of the strut skin. If the mandrel is constructed to the outside skin measurement not only of the upper and lower airfoil surfaces, but also of the leading and trailing edges, it can be seen that both work-piece and mandrel material, when restruck, would have no place to go. To prevent buckling of the work and possible damage to press tooling, the leading and trailing edges of the finished mandrel are cut down in size by an amount equal to the thickness of the work-piece material. It is the waxing-in of these areas in the "reverse" cavity that provides the necessary clearance to allow the plastic to flow.

In the third major step the two halves of the "reverse" are locked up. The unit is set on a surface plate and openings that might result in leaks are dammed off. A plaster mix is then poured into the cavity and allowed to harden. After a sufficient period of time the mold is opened and the plaster "splash" is removed. The splash is a duplicate of the original master with one important exception—it embodies the necessary allowances for material flow at both the leading and trailing edges.

During the fourth stage an aluminum mold is pressure-cast around the plaster splash. The mold cavity has the final desired shape of the mandrel. To permit easy removal of the mandrel that is to be cast in this mold, the surfaces of the cavity are first coated with a lacquer-base parting film.

Fig. 1. This group of typical sheet-steel jet-engine parts illustrates the diversity of aircraft work being handled with plastic-faced press tools.

Fig. 2. (Right) Steel-cored plastic mandrel, top, is used during restriking of the airfoil-shaped strut skin shown at the bottom. Sequence of stages are preformed skin, left; restruck skin, center; and assembled strut, right.

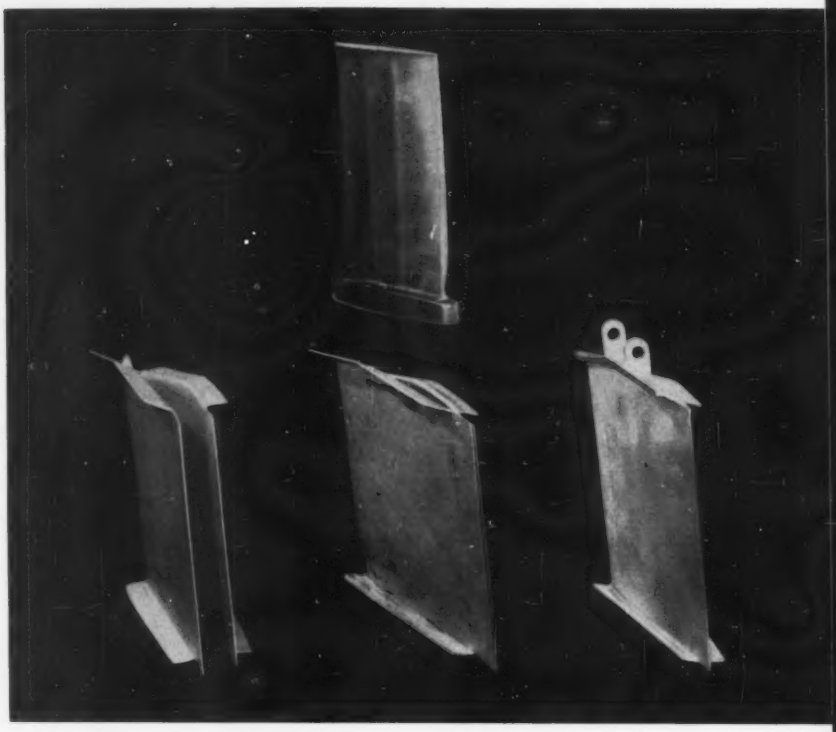


Fig. 3. (Below, left) The "reverse" (heading illustration) is used to obtain a plaster "splash," around which an aluminum mold is subsequently cast. Nylon mesh is wrapped around a steel core and is shown being inserted into this aluminum mold.

Fig. 4. (Below, right) A liquid epoxy casting resin is poured into the mold cavity, surrounding the nylon-wrapped steel core. The mold rests on a vibrating table to drive any air bubbles from the plastic.

When the film has thoroughly dried, the surfaces are waxed.

The mandrel emerges during the fifth, and final, stage. A nylon mesh fabric is wound around a steel core, which can be of either rectangular or an airfoil cross-section. Several layers of the nylon mesh are wrapped around the core. Care is taken that the beginning and end of the fabric lie on the flat, broad surfaces of the core, and not on the edges. A wound steel core is then inserted into the cavity of the aluminum mold as can be seen in Fig. 3.

With the mold resting in an upright position on a vibrating table (Fig. 4) resilient resin or other synthetic material is slowly poured into the cavity, completely surrounding the nylon-wrapped steel core. Vibration of the table drives any air bubbles from the liquid plastic to assure a sound casting. When mixing the plastic just prior to use, a catalytic agent is thoroughly blended with the resin. Although polymerization takes place shortly after pouring, the cast mandrel is allowed to cure for a period of seventy-two hours before being used.

Illustrated diagrammatically in Fig. 5 are the various steps undergone by the strut skin during restriking—from the preformed part at A to the reshaped part at E. The plastic mandrel is inserted into the preformed skin, as at B. This assembly is then positioned in the lower member of the restriking die, as at C, which is set up on a hydraulic press.

When the press ram descends it applies a slow squeeze to the work. As the upper and lower steel die members come together they force the strut skin to close around the mandrel. It is at this point that the advantages of plastic tooling become apparent.

As the two legs of the part are forced together by the die, pressure is built up in the plastic surface of the mandrel. This pressure partially displaces the plastic, causing it to flow in all directions. Allowance was made for the movement of sheet metal and plastic (as has been described earlier) by the waxing-in step performed on the "reverse."

Although most of the displaced plastic has some place to go, considerable pressure is exerted by the mandrel against the inner surfaces of the strut skin. The wiping action of the shifting plastic, together with the outward pressure of the mandrel when the dies have bottomed as at D in Fig. 5, impart a definite set to the work-piece, thus almost entirely eliminating spring-back

Fig. 5. Various steps in obtaining the final airfoil shape of a turbine exhaust strut skin. The preformed part is shown in View A; the mandrel is inserted and the skin positioned in the die, View C; and the restruck part in View E.

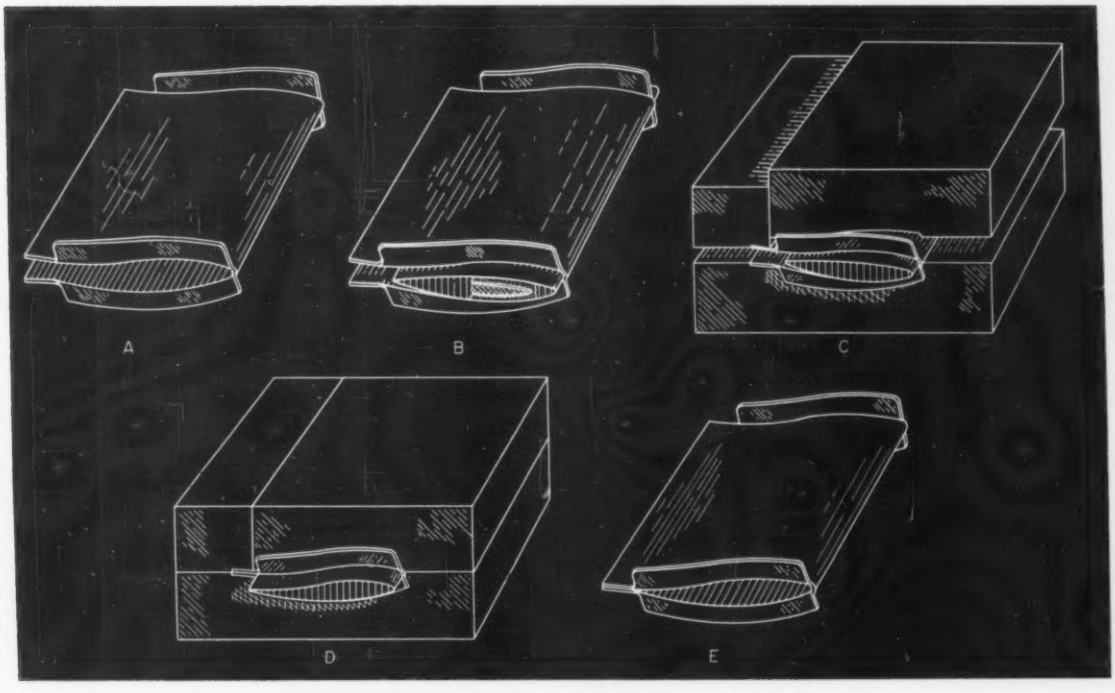


Fig. 6. Die pressure applied to the work compresses the mandrel, causing the plastic surfacing to exert outward force against the work, thus giving it a set. A mandrel is shown being removed from the restruck part.

when the dies are opened. In Fig. 6, the strut skin has been finish-formed and the operator can be seen removing the mandrel.

External Forming with Plastic-Faced Dies

Plastic surfacing is by no means restricted to mandrels and other internal forming tools. On the contrary, other applications are possible on standard types of press tools such as the restriking and piercing die illustrated in Fig. 7. Here, the entire contact area of the male member is faced with plastic.

As might be expected, the procedure followed in making a die such as this differs somewhat from that followed in making a mandrel. If a casting is to be used, a plaster pattern is first made of the punch member to be surfaced. This pattern is 1/4 inch undersize on the working surface to allow for the plastic face. A punch of either Kirksite or Meehanite is then sand-cast and prepared for surfacing. The punch may also be rough-machined 1/4 inch undersize.

Holes are drilled into the casting from the outer surface to the working face to provide a flow path and vents for the liquid plastic. In the meantime, the female member is machined from die steel in the conventional manner to basic blueprint dimensions. (The die members can also be made in reverse.)

For the next step, the die set is assembled and the punch member is positioned to leave a gap of approximately 1/4 inch between the two working faces. Steel straps are then screwed in place to maintain proper positioning. Just prior to this assembly, however, the working face of the steel female member is prepared with parting agents. An alternate method would be to use a plaster cast in the backup.

Edges of the die members are dammed up to contain the liquid plastic. When this is done, freshly mixed resilient plastic is poured into a sprue pipe that connects with a hole drilled into the punch member, Fig. 8. The cavity between the faces of the two members is thus filled with the plastic material.

A curing period—either in air or in an oven—is allowed before anything further is done. At the end of this time, and without unstrapping the die halves, the assembly is placed on the table of a vertical boring mill. With the work resting on the

Fig. 7. Plastic facing is widely used on standard types of press tools such as this restriking and piercing die. The forming area of the male member (bottom) is surfaced with a layer of plastic about 1/4 inch thick.

finished mounting face of the female member, truing cuts are taken across the mounting face of the male member.

Another press tool constructed, in part, by the same method is the restriking and piercing die illustrated in Fig. 9. It is used to finish a turbine inner-seal support such as the one shown at *B* in Fig. 1. Initial shaping of the stainless-steel blank is done on a Cincinnati Hydroform. From this operation the parts are brought to the 1500-ton Lake Erie press, on which the illustrated die is mounted, for restriking and piercing.

Although the inner-seal support may not appear to be a highly precise part, there are two circular mounting areas that must be maintained flat and parallel within 0.002 inch full indicator reading. These are noted on the modified half-section of the part shown in Fig. 10. The first die used for restriking was of all-steel construction and did not prove satisfactory. Most of the parts turned out did not meet assembly requirements. Despite the fact that both the die surface and the punch were recut a total of six times within one year, the results did not come up to expectations.

It was then that the plastic-facing technique was employed. As can be seen in Fig. 9, the entire ring-shaped contact area *C* of the lower die member is surfaced with plastic approximately 1/4 inch thick. This member is supported on a die-cushion that is set to resist an applied load of 160 tons. A punch, noted at *D*, is mounted in a fixed position on the die-shoe for piercing.

A Hydroformed turbine inner-seal support is

Fig. 8. Punch member is made about 1/4 inch undersize on its working face. It is then strapped to a conventional steel die half, maintaining the 1/4-inch gap. Edges are sealed and plastic is poured through drilled holes into the die cavity.

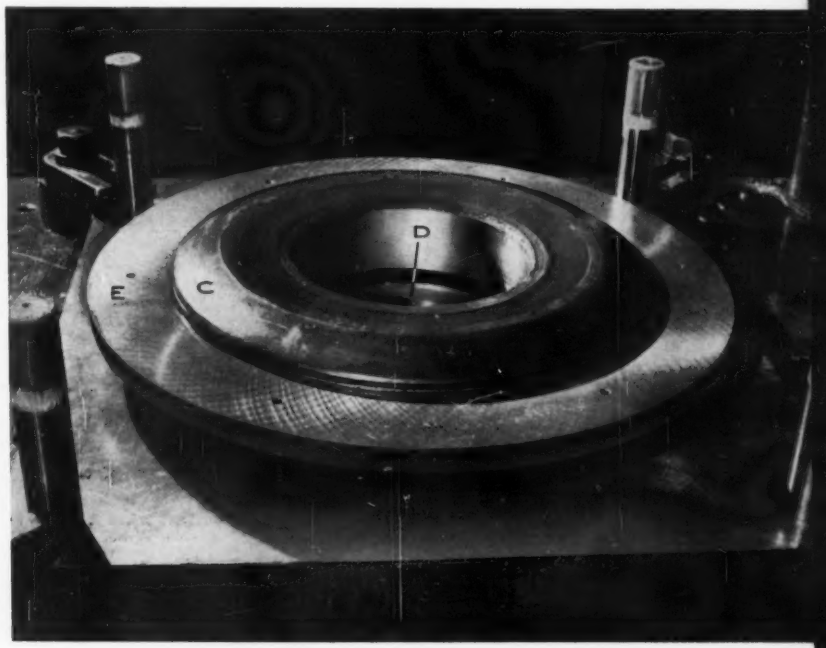


Fig. 9. Restriking and piercing die for a turbine inner-seal support. Circular forming area (C) is faced with plastic. Mounted on a die-cushion, this member is forced downward past fixed punch (D) to re-form and pierce.

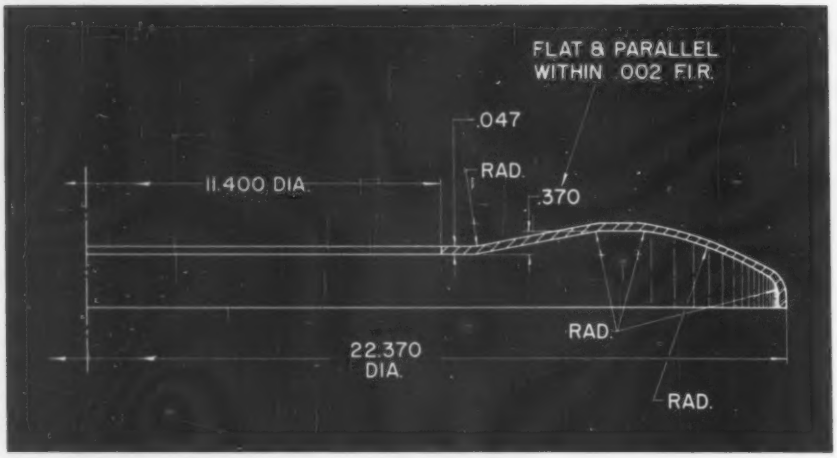


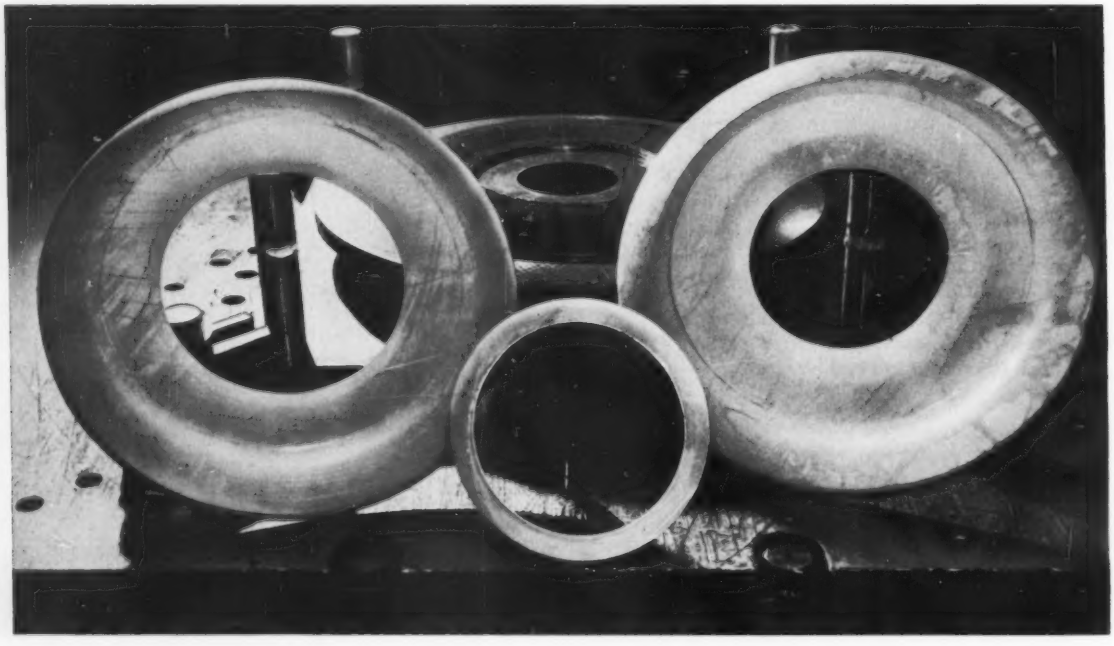
Fig. 10. Half-section of turbine inner-seal support that is restruck on the die seen in Fig. 9. The tooling holds two critical circular areas flat and parallel within 0.002 inch full indicator reading.

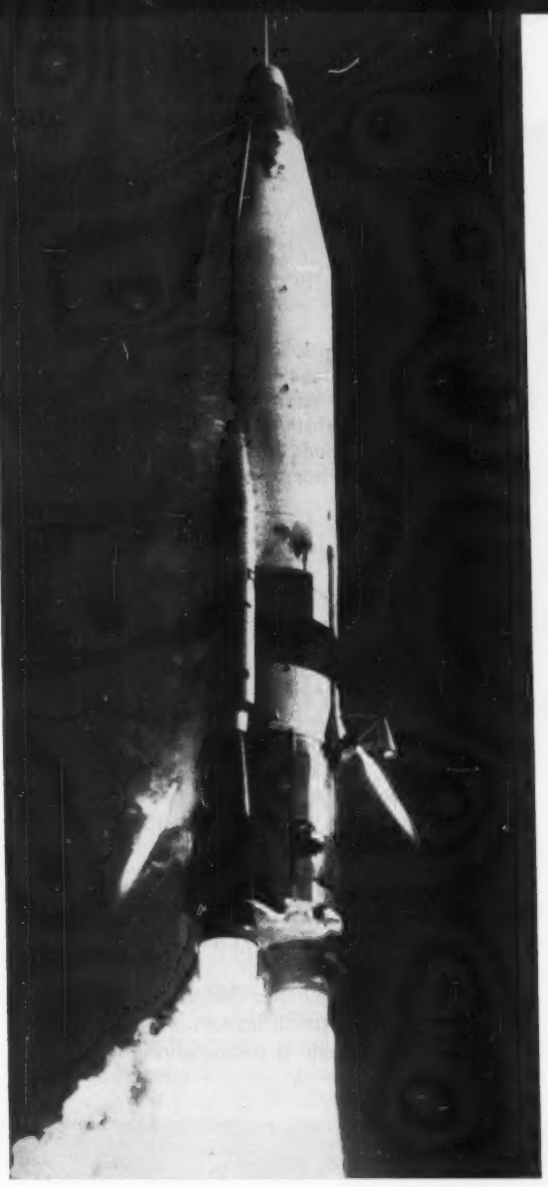
placed on the plastic ring with the die-cushion raised. As the upper die descends and makes contact the work-piece is securely nested. When sufficient pressure builds up to override the die-cushion, the plastic-faced ring is forced downward past the stationary punch to enlarge the center hole.

After the dies have bottomed, a 700-ton load is applied. Under this compression the plastic die surface acts in much the same way as did the plastic mandrel surface already described—its flexible nature permits it to push outward in all directions, forcing the sheet-metal work-piece to accurately assume the contour of the upper die cavity.

Stripper ring *E*, Fig. 9, encircles the forming ring and breaks the work loose as the dies open. Pins housed in the female die strip the work from the upper member. Shown in Fig. 11 are a preformed inner-seal support, right; a restruck inner-seal support, left; and a scrap ring from the piercing stage, center. It is of interest to note that if a wide flange were present on the preformed part it, too, could be trimmed in the one operation.

Fig. 11. A preformed inner-seal support is shown at the right, a restruck part at the left, and a punched scrap ring in the center. The plastic-faced die can be seen in the background.





GEARS FOR OUTER SPACE

Torturous demands are being made on rocket-engine gears—which must be of small size, light weight, and near-perfect accuracy. This article discusses some of the considerations in designing such gears, and points out the urgent need for better production equipment all along the line.

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ROCKET-ENGINE GEARS such as those seen in Fig. 1 are designed to function in the environment of outer space. Knowledge gained from the problems encountered under these conditions of astrokinetics has enabled us to extend the operating limits of today's gearing. Proper application of this data should enable all types of gears to carry greater loads more efficiently.

First, it is of interest to know why gears are needed in a rocket engine. A liquid-powered rocket carries not only fuel, but its source of oxidation. To obtain its great power for thrust, tremendous amounts of liquid oxygen and fuel must be pumped into the thrust chamber, where they are burned. Pumping is generally done by centrifugal impellers, which get their power from a turbine driven by a gas generator. Optimum speed of the turbine is generally not compatible with that of the pump impellers. The turbine speed is higher, and a reduction is needed to deliver the proper, slower speed to the pumps. This speed reduction is accomplished by gears, as shown in Fig. 2, a rudimentary outline of a rocket engine.

Environmental and operating conditions under which rocket gears must function demand adherence to certain rigid specifications, including the following:

Size. Smallest area and volume feasible.

Weight. Minimum possible—approximately 0.05 to 0.02 pound per horsepower for the entire assembly of main power gears, shafts, bearings, and cases; or 20 to 50 horsepower per pound of gear-box.

Acceleration. 0 to 15 g's for the entire case. The gears accelerate from 0 to 25,000 feet per minute (pitch-line velocity) in 0.3 second.

Altitude and Pressure. Altitudes vary from sea level to near infinity, and atmospheric pressure changes from about 15 to near 0 psi.

Temperature. Operating temperatures in the vicinity of the gear-case vary from minus 350 degrees to plus 400 or 500 degrees F.

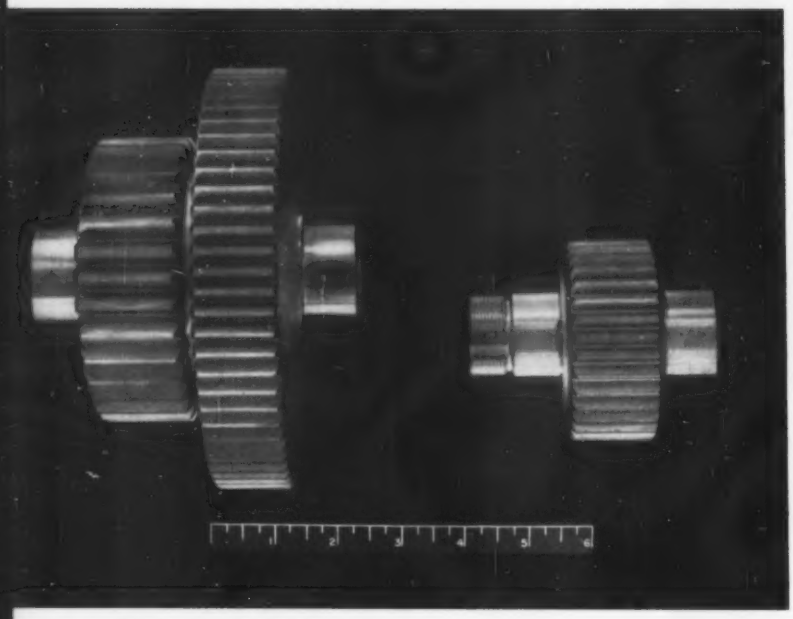


Fig. 1. Typical gears employed in rocket engines must be of near-perfect accuracy to withstand the torturous demands of operating in the environment of outer space.

Life. Flight time depends on the missile in which the gears will be used. Actual time in test stands varies from 4000 to 10,000 seconds, and the design life is generally predicted at ten hours maximum.

Loads. The dynamic driving load on the gear teeth is normally over 4000 pounds per inch of face width. Also, static and dynamic external loads are often applied to the gear-cases from the pumps and frame of the missile.

Speed. From approximately 6000 to 40,000 rpm with pitch-line velocities up to 30,000 feet per minute.

Lubrication. Minimum possible amount and weight of fluid to cool and lubricate the gear teeth and bearings. Approximately 1 gallon per minute for 1000 hp.

Although there are other demands, it has often been said that the most important requirement of a rocket or a missile is reliability. The formula

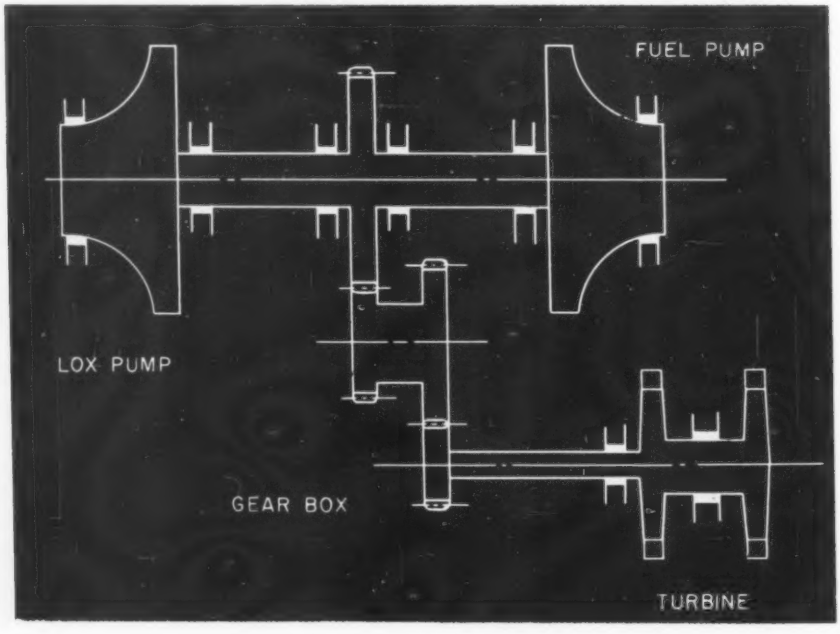


Fig. 2. Rudimentary outline of a rocket engine shows how a gear-box is used to reduce speed of turbine for driving liquid-oxygen and fuel pumps.

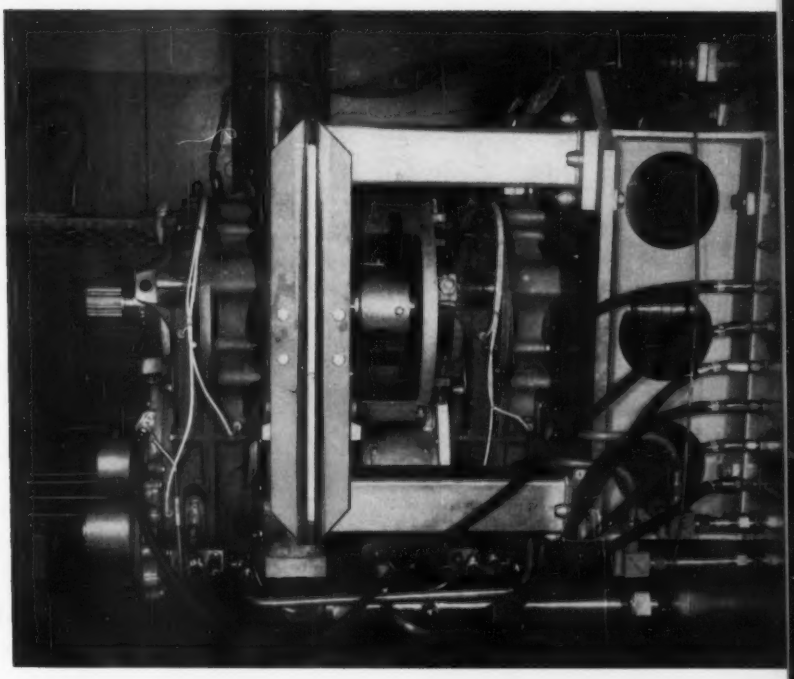


Fig. 3. Back-to-back gear test stand with gear-box being tested at left and slave gear-box near center. Drive bulkhead and input shaft can be seen at right.

for gear "reliability" is the proper mixture of the following ingredients:

A. Take the best-known test data and gear engineering.
B. Add untested data and new ideas which appear feasible and workable under the conditions of astrokinetics.
C. Subject these to cruel, torturous tests in back-to-back gear stands (Figs. 3 and 4) and static firing stands, such as those used at Rocketdyne's Santa Susana test station, Fig. 5.
D. Put these components in an actual missile, fire it, and find out from the telemetered data what is wrong.

Then start back at "A" again. This is a never-ending cycle in the search for complete perfection and reliability.

Design and engineering knowledge is based mainly on years of test results, and on data known about precision aircraft gears built for a short life at high speeds and heavy loads. AGMA publications and other late engineering formulas and data are utilized. The best-known consultants in the United States and abroad are employed, and data is interchanged between North American Aviation and other companies.

The allowable fatigue-stress limits are constantly being determined from such test data. Besides many minor and basic values that are calculated, there are also three main points for which calculations are made: root bending stress, Hertz or compressive stress, and scoring for PVT and flash-temperature formulas.

The root bending stress is calculated from a modified Lewis formula:

$$S_t = \frac{W_t \times P_d}{F_e \times Y} \times K_a \times K_r$$

where S_t = root tensile stress, in psi;
W_t = tangential driving force, in pounds;
P_d = diametral pitch;
F_e = effective face width in inches;
K_a = application factor;
K_r = stress concentration;
Y = tooth-form factor, based on AGMA method and determined from layouts.

As would be supposed, calculated values for S_t are very close to the allowable limits. However, one of the unknowns in the formula is the stress-concentration factor. Published figures have been tried, but the calculated values always exceed those allowable. Experience shows that the factor varies between 1.0 and 1.5 for carburized gears. However, more exact values are needed, and Rocketdyne currently has a program to determine these values very accurately.

Hertz compressive stresses are generally calculated at the first and last points of contact, at the points of single tooth engagement, and at the pitch line. However, calculations show that these values vary only slightly. As a result, the value

Fig. 4. Automatic recording device and control instruments employed in conjunction with back-to-back test stand seen in Fig. 3.

at the pitch line is used in most cases, and is calculated from the two formulas:

$$K = \frac{W_t (M_G + 1)}{d \times F_e \times M_G} \quad (1)$$

where K = factor or index of compressive load;
M_G = ratio of gear teeth to pinion teeth;
d = pitch diameter of pinion.

and

$$S_c = C_k \sqrt{K} \times K_a \quad (2)$$

where C_k = 5236 (for 25 degrees);
S_c = Hertz compressive stress.

Calculations are also made for depth of case, which is at least twice the depth of maximum sub-surface shear. Scoring calculations are made for both PVT (pressure, velocity, and distance) and flash-temperature formulas. It has been experienced that both of these values are inaccurate, but it appears that the flash-temperature value for scoring is the more accurate. However, an even more precise method of determining scoring risks is required. A PVT limit of 2 to 4 million is used for higher-speed gears (pitch-line velocity above 15,000 feet per minute), and a temperature limit of at least 50 degrees under the scoring flash point of the oil. It has been suggested by some gear engineers that S_c times Kelley's flash temperature would be a better compromise.

All of the designs are reviewed for the balanced risks of compressive stress, root bending stress, and scoring, and necessary changes in addendum and thickness proportions are made when needed. Most of the data shows that scoring is less of a risk than supposed. Root stresses and conditions are one of the most critical items in rocket gearing.

As stated previously, three main testing systems are used. In the four back-to-back test stands, gear transmissions are subjected to a predetermined amount of torque and operated. These stands have the additional advantage of being operable under varied temperatures and loads, as well as under different atmospheric pressures, to simulate altitude conditions. All turbo-pumps and gear-boxes are anchored in static test stands and "hot-fired" before shipment of the engine to the customer. The performance data is supplied to and reviewed by engineering. The last test is the actual flight of the missile, from which performance data is telemetered. An Atlas missile is seen in flight in the heading illustration.

From these tests, valuable improvements and corrections accrue which save many dollars of the defense budget. The knowledge gained should prove invaluable in other gearing applications.

Quality control, inspection, and manufacturing comprise the greatest problem areas in the production of such gearing. Rocketdyne does not make gears, but relies mainly on independent vendors. In doing this, it is necessary to double-check every gear, just as if it had been made by us. Complete tooling layouts of every gear are made. These are often double-checked by an independent gear tooling concern, in addition to the firm who will make the gear. With this kind of cooperation, many problems and trouble spots are eliminated even before production has started.

Another phase of this problem is that no matter how much data is contained on a drawing, it is impossible to eliminate various interpretations by different people. Cooperation and understanding must exist between the supplier and the buyer so that changes can be made quickly as new facts are learned. The drawings must show

complete information so that the parts may be controlled from the raw forgings, through heat-treatment, to the final modified tooth profiles of the finished gears. The tooth-profile chart is one good example—when several different manufacturers were asked to agree on a true involute with a 0.0003-inch tolerance, a wide variation of opinion was revealed. The best chart found, shown in Fig. 6, eliminates this area of misunderstanding.

Getting parts made to close tolerances has caused much consternation. Many gear manufacturers have had difficulties meeting our requirements. Yet, repeatedly, gear drawings from other countries have been seen in which the tolerances and values specified are twice as critical. These tolerances apply on profiles, roots, whole depth, and other items.

If the United States is to maintain its superiority in the field of gearing, it must find more exact and better means of manufacturing. It is estimated that United States gear manufacturers are falling behind in tolerance controls. Yet, greater demands for more accurately made parts is the order of the day in rocket-power transmission.

Complete understanding must exist between engineering, inspection, and quality control. While it is realized that perfect parts are impossible to obtain, inspection can measure all the dimensions and find the errors. Quality control can enforce the necessary corrections. With this complete inspection data and test results, engineering can determine what limits can be granted. Causes of failures can also be traced and eliminated.

Contrary to popular belief, gears operating under astrokinetic conditions must be of the highest quality, even though they operate for only extremely short periods of time. It is impossible to compromise on quality, and the best design and manufacturing techniques are required for the complete gearing, bearing, and lubrication systems. Once these qualities are in a system, and every dimension is held to the specified tolerance, greatly increased load-carrying ability is available—approximately twice what is used for manned aircraft. What is ironical is that a failure in an aircraft engine generally risks not over a hundred lives, yet the failure of a defense missile, when attacking another missile, could result in the death of thousands.

Some of the specific data and knowledge that has been gained can be summarized as follows:

1. The best rocket gear has a pressure angle of 20 to 25 degrees and is of the spur type.
2. A modified profile gives the best results. To date, a modified barrel form is used, but, presently, it is intended to use addendum modification only, as shown in Fig. 6.
3. Modified gear profiles have relieved all scoring problems to date.
4. Contact ratio must be higher than 1.2. Values of 1.4 and above are optimum.
5. It is possible to get unusually good results out of stubbed gear proportions, but best results are obtained from pinions having a modified thickness and a long addendum, and gears having a short addendum. The use of long addendum pinions has approximately doubled the life of parts and their reliability, with only one third the vibrations, as measured by accelerometers.
6. A minimum case hardness of 60 Rockwell C and a minimum core hardness of 36 Rockwell C are specified on the latest drawings. A decrease in hardness of only 2 points can cause failure.
7. In rocket gears, roller type bearings are generally used.
8. Bearings having a crowned outer ring with outer land-riding cages for the rolling elements will tolerate more misalignment, and are not as

Fig. 5. Firing rocket engine on static test stand at Santa Susana station of Rocketdyne, a Division of North American Aviation, Inc.

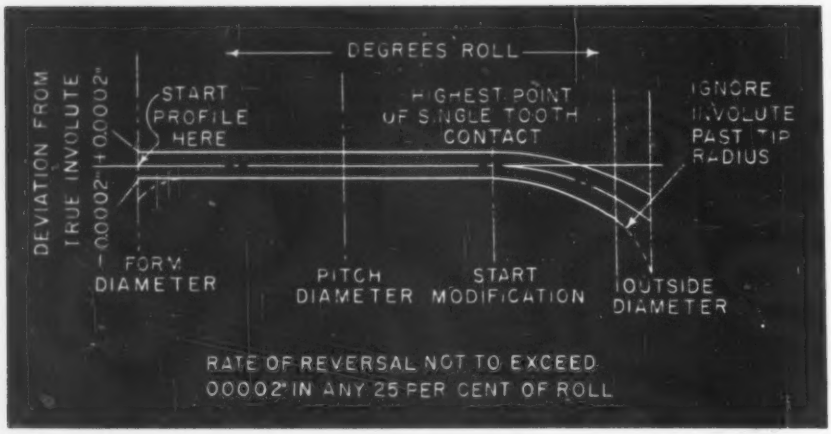


Fig. 6. Tooth-profile chart recommended to avoid differences of opinion among various manufacturers.

critical to lubricate. This design allows up to twenty times the life under the same load conditions.

9. The low temperature imposed on the gearbox by the oxidizer can be overcome by electrical heaters.

10. Better and longer life, and resistance to fatigue, are obtained by shot-peening the parts—approximately 10 to 30 per cent increase in bending in gear and spline roots, and 10 to 400 per cent in the webs of gears.

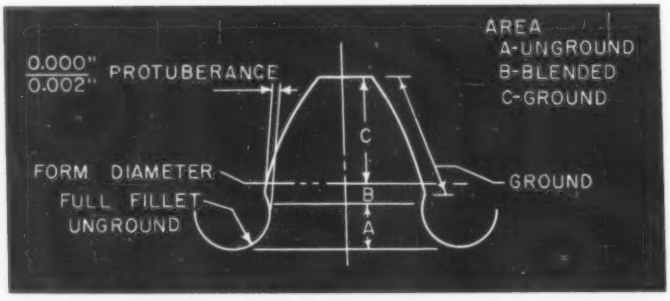
11. Grinding in the roots cannot be tolerated since it causes premature root fatigue—about two to three times faster. In testing one group of ground-root gears, 90 per cent failed within a time variation of only 400 seconds.

12. The ideal root gear shape is as shown in Fig. 7. However, while it is not desirable, it is feasible to tolerate and have satisfactory operation from ground gears of the type seen in Fig. 8. Values are shown for about 10-pitch size gears. This has proved an invaluable aid to manufacturers, and, to date, has shown no marked reduction in operating life.

13. Gears can be pitted and scored and still operate for quite some time.

14. The ideal lubricating system consists of fog nozzles on the incoming side and sprays for the leaving side of a gear mesh. Since a one-pass system of lubrication is used, lubricating only the leaving side is necessary. Quite often, a welcome secondary, beneficial fog is generated.

Fig. 7. Ideal root gear has a 0.000- to 0.002-inch protuberance blended into upper ground portion and unground fillet.



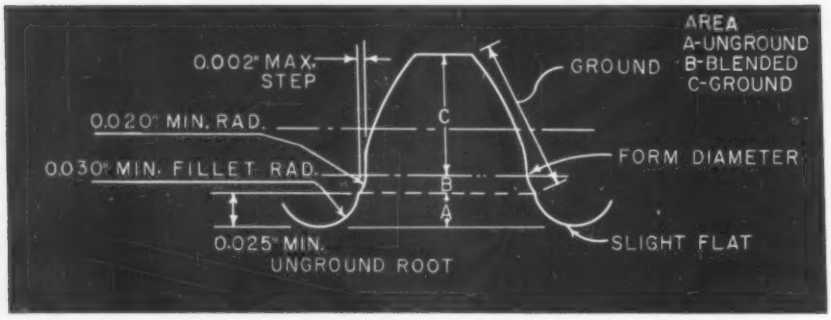


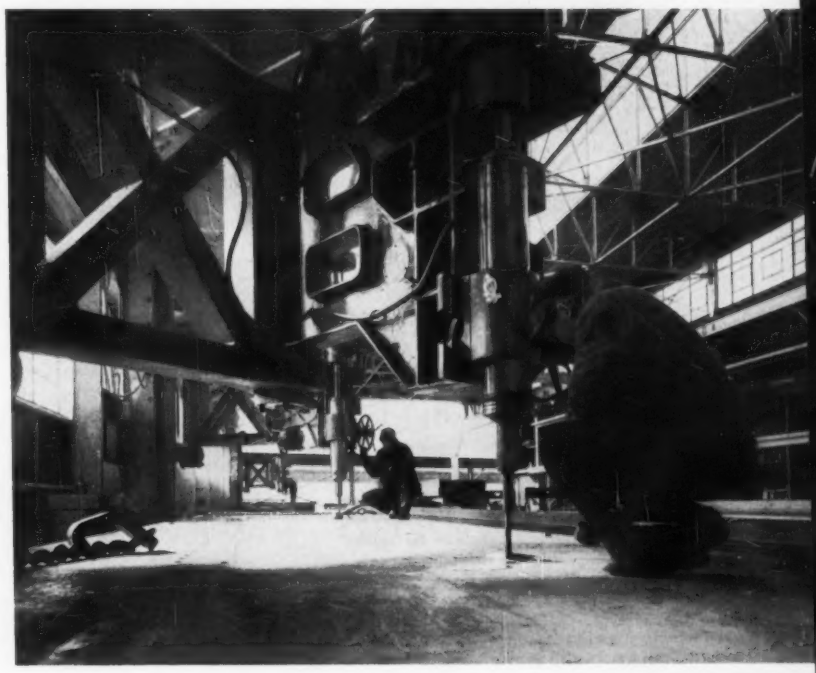
Fig. 8. Less desirable tooth form which is easier to produce and has shown no marked reduction in the operating life.

15. Lubricant MIL L-6086 has been used, but much better performances have been gained through using MIL L-25336. This is especially true when considering temperature and pressure operating variations imposed on the gears.

16. Disadvantageous conditions at altitudes of 100,000 feet and above are not as anticipated: they are much worse. Lubricants operating at high altitudes and resultant low pressures often exhibit some very undesirable characteristics, one of which is foaming. In one test, a sample bearing was cut away, and an oil lubricant was directed through the inner race and its cage. It was observed that the lubricant satisfactorily reached the area of contact between rollers and inner race when operated at pressures corresponding to sea level. However, when the same oil was operated at pressures corresponding to those encountered at an altitude of 150,000 feet, the entire area was engulfed in foam, as seen in Fig. 9, resulting in very poor cooling. This tendency to foam varied at different pressures and with various lubricants. Also, there was a marked difference in the types of foam, the ability of the bubbles to burst, and the wetting and cooling capabilities.

As soon as a design seems optimum, something new is learned, or conditions change so that facts are not available. There is a constant learning and testing cycle, and it would not be surprising to find that a lot of the present data will not be applicable in the future. Through open-minded use of test data, new advances in the state of the art of gearing are made. It is believed the facts learned are not only of value in the defense and missile industries, but also applicable and of value in other fields of gear engineering.

Fig. 9. At pressures corresponding to an altitude of 150,000 feet, cooling action of the oil is reduced due to the foaming action.



Three Baush radial drills prepare a top chord section for a steel bridge in the new girder shop of Bethlehem Fabricators, Inc., Bethlehem, Pa. The machines, of double-arm design, are supported from 14-foot-high cranes which move laterally on top and bottom rails. The cranes and drills can operate over a distance of 140 feet, making it unnecessary to reposition the sections.

Threading on a Tool and Cutter Grinder

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A tool and cutter grinder doubles as an external thread grinder when equipped with a fixture which both revolves and advances the work in a helical path. Since the fixture is designed specifically for work of a given outside diameter and a given thread pitch, its use is more practical for quantity-lot grinding than for a single piece.

In Fig. 1, the work *A* is in the process of being ground by the wheel *B*. The grinding wheel is directly above the work, and the machine table is offset to the helix of the required thread. By turning handwheel *C*, a lead-screw spindle within stationary bronze nut *D* is made to revolve and advance toward the grinder wheel-head. The work is contained in the lead-screw spindle, the nose of which is a split collet.

In Fig. 2 are illustrated the disassembled parts of the fixture. The major body portion of spindle *E* is a lead-screw, identical in pitch (1/8 in this instance) to that of the ground thread required. This spindle engages bronze nut *D*, which is secured to frame *M*. A split in the wall of the nut permits it to be adjusted by set-screws to a snug fit with the spindle.

Worm-gear *F* is keyed to the rear end of the spindle, meshing with worm *G* to which handwheel *C* is attached. Dovetail slide *H* is a carrier for the worm, moving along the top of the frame as the spindle advances. This movement is trans-

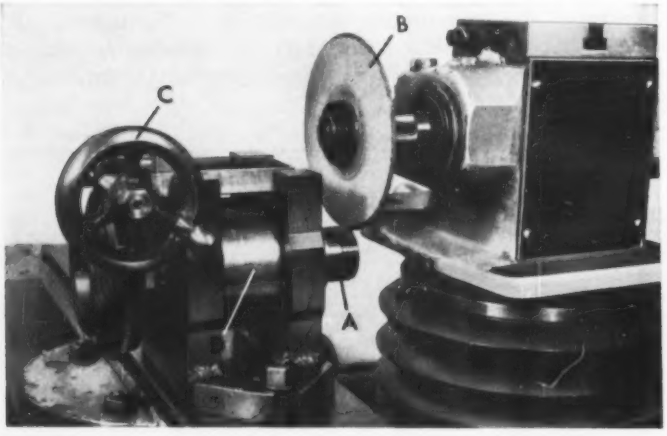


Fig. 1. (Above) By turning handwheel (C), the spindle carrying work-piece (A) is both rotated and advanced beneath the grinding wheel (B).

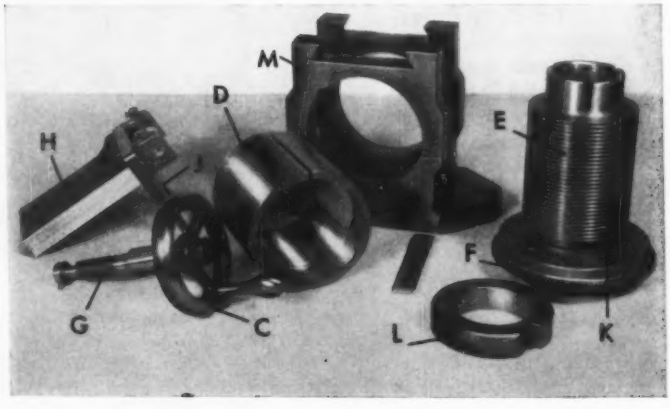
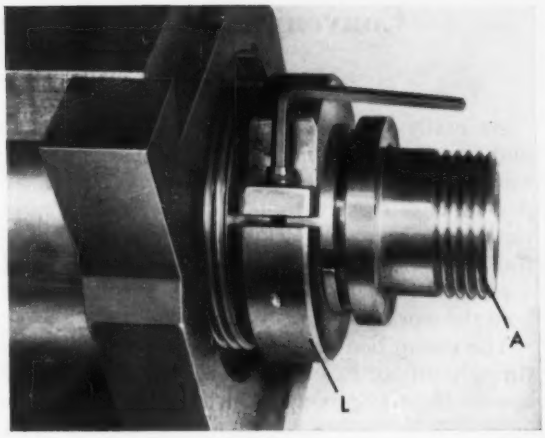


Fig. 2. (Right) Since the pitch of nut (D) and spindle (E) must be the same as the thread required, the fixture is practical for quantity-lot grinding.

Fig. 3. The nose of the spindle is a split collet which grips the work (A) when collar (L) is tightened.



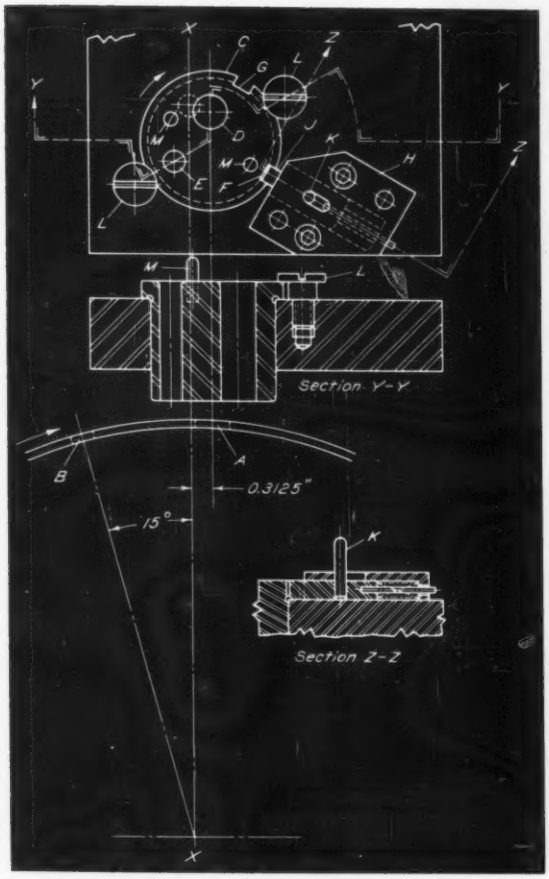
ferred through the engagement of yoke *J* on the end of the slide with neck *K* located on the spindle adjacent to the worm-gear.

The spindle, a hollow member, has an inside diameter corresponding to the outside diameter of the work. To grip the work, collar *L* is tightened around the nose of the spindle as illustrated in Fig. 3.

Thread depth is controlled by the vertical adjustment of the grinder wheel-head. The rotation of the work through the worm-gear permits the needed slow feed, and also helps control the dwell in making a neat thread termination. The machine table also carries a thread-truing device. When the wheel needs to be trued, the table is unlocked and run over until the device is in position. A witness mark scribed on the table assures that it can be accurately returned to grinding position after the wheel is trued.

One Drill Bushing Locates Two Holes

CLIFF BOSSMANN, Dayton, Ohio



Two holes, one off-center and one radial, were drilled through the wall of a cylindrical part by using a jig having a single, rotatable bushing. Separate bushings could not be used because of the close spacing between the holes. The work-piece, approximately 12 inches in diameter, was held on a large dividing head.

Features of the bushing design appear in the illustration. From the reference center line X-X of the work-piece, off-center hole *A* is located a distance of 0.3125 inch. Radial hole *B* lies 15 degrees from the center line, in an opposite direction. The rotatable jig bushing *C* has two holes, *D* and *E*, corresponding to the holes *A* and *B* to be produced in the work-piece. Notches *F* and *G* are 90 degrees apart in the bushing periphery.

The bushing position illustrated is for drilling hole *A*. Next to the bushing is a locator *H* having a plunger *J* which engages notch *F*. To drill hole *B*, the plunger is retracted by handle *K*, and both the work-piece and the bushing are indexed in the direction indicated by the arrows—the work-piece, 15 degrees, and the bushing, 90 degrees, so that notch *G* is then engaged by the plunger.

During drilling, lock-screws *L* secure the bushing against movement. When the bushing is to be indexed, a pair of pins *M* provides a convenient means of rotating it.

Illustrated position is to drill hole (A). For drilling hole (B), bushing hole (E) is on center line (X-X).

Convenient Work-Clamp for a Vertical Boring Mill

A. G. Amos, Calcutta, India

An easily operated clamp for rapid positioning and securing of cylindrical work-pieces to the table of a vertical boring mill is here illustrated. A number of these work-holding devices are positioned on the machine table and pre-set to centralize the part. An almost effortless movement of a weighted lever on each clamp is sufficient to hold the work-piece for boring.

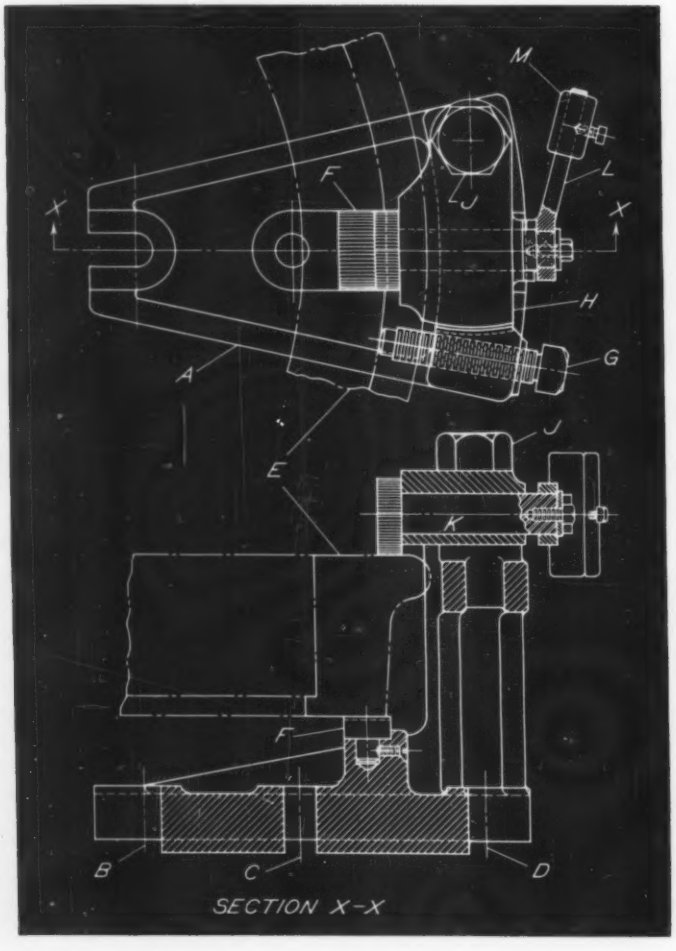
The clamp body *A* is made of cast steel and is strongly proportioned. A key is machined on the base of the clamp body to fit the slots in the boring-mill table. Bolts (not shown) located at *B*, *C*, and *D* fasten the clamp to the machine. A work-piece *E*, being secured by several clamps, is supported, in part, on each by a serrated and hardened block *F* and is positioned, in part, by a set-screw *G* in each clamp. These set-screws are previously adjusted to centralize the part. After locating the work-piece, the set-screws on all the clamps are lightly tightened, as great pressure on these screws is not necessary. Arm *H* pivots on bolt *J* and supports camshaft *K*, clamping lever *L*, and weight *M*. The pivoting action of the arm is to permit removal and loading of the work-piece.

Immediately after tightening the work-centralizing set-screw *G*, arm *H* is swung inward and lever *L* is rotated clockwise to grip the part by means of an eccentric cam integral with camshaft *K*.

The inward movement of arm *H* is limited by a projection welded on it to act as a stop. In addition, arm *H* has a shoulder that fits in a recess in the clamp body. This shoulder takes the clamping thrust. For gripping purposes, the surface of the cam is finely serrated. A stop is also provided on lever *L*.

The direction of the clamping action is such that the heavier the thrust, the more rigidly the work-pieces are held. The number of clamps used on a part will depend on the size and nature of the work. Four of these clamps were used with success in the boring of railroad tires.

Work-clamp that facilitates boring operations on a vertical boring mill. Cutting thrust on work-piece only serves to increase clamping pressure.



* * *

Film Shows Huge Forging Presses in Action

"Hands of the Giants," a 16-millimeter sound-color film recently released, shows the forging of highly intricate aircraft components on the world's largest closed-die presses. Shot at the North Grafton, Mass., plant of the Wyman-Gordon Co., the thirty-minute film explains why the conquest of the air in the missile age requires massive forgings in unusual sizes and shapes. Billets of titanium, magnesium, steel, and aluminum are shown being forged on multiple-story presses of 18,000, 35,000, and 50,000 tons. "Hands of the Giants" is available without charge from the Wyman-Gordon Co., Worcester 1, Mass., for showing to engineering schools and industrial groups.

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Send a scale drawing (or photograph—or both) that shows the operating principle and important parts involved. Clear blueprints or pencil drawings are acceptable, but free-hand sketches cannot be used.

Describe the *purpose* and *action* of the mechanism—*how* it does *what* it does. Your description need not be in polished English, but it should be clear and logical.

Mark details on drawing, such as levers, cams, and gears, with letters *A, B,* etc., and use corresponding letters to identify those details in the description; thus, "Lever *A* is operated by cam *B*." (A suggestion: See how articles in this issue's "Ingenious Mechanisms" section are handled.)

Substitute a diagram for the drawing, if necessary, to illustrate the arrangement of a complicated mechanism.

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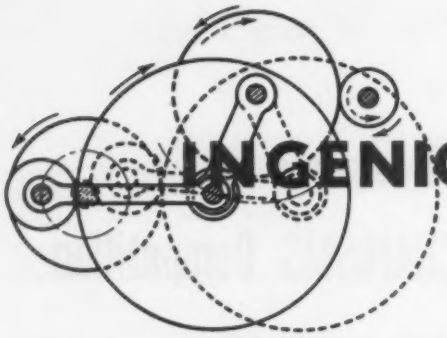


INGENIOUS MECHANISMS

Mechanisms selected by experienced machine designers as typical examples applicable in the construction of automatic machines and other devices

Eccentric Gears Feature of Bag-Folding Device

RALPH T. STEWART, Winston-Salem, N. C.

One functional requirement of folder blades on a machine for making foil bags is that the first fold should not interfere with the second fold. This is necessary to prevent wrinkling and turning of the edge of the first fold. A pair of eccentric gears was arranged as shown in the accompanying illustration to accomplish the proper folding action.

Eccentric gear *A* is secured to the shaft integral with part *B* which carries folder blade *C*. Similarly, eccentric gear *D* and folder blade *E* are attached to part *F*. The pitch radii on the gears are indicated by R_A and R_D in the illustration. Bearings in housings integral with the machine frame *G* support parts *B* and *F*. Eight bag-forms *H* are mounted on a turret (not shown) having a Geneva motion which intermittently indexes one after the other into position between the two blades for the folding operation. A drive connected to part *B* rotates blades *C* and *E* through an angle of 180 degrees to fold the foil on each form in its turn.

In operation, as folder blade *C* rotates 135 degrees, blade *E* travels through an angle of 117 degrees. At this instant blade *C* lags blade *E* by 18 degrees, and this lag permits the portion of the foil *J* carried by blade *C* to clear the portion carried by blade *E*. During the remaining 45-degree

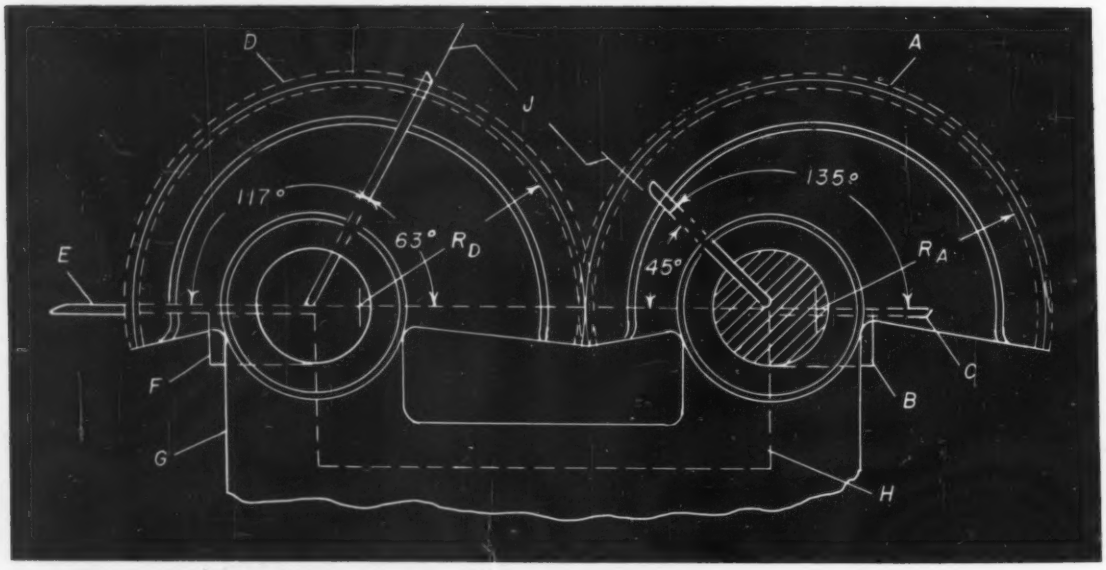


Fig. 1. Eccentric gears arranged to facilitate folding of foil on a form in a bag-making machine. Interference between the folds is prevented by the motion imparted to the folding blades by the gears.

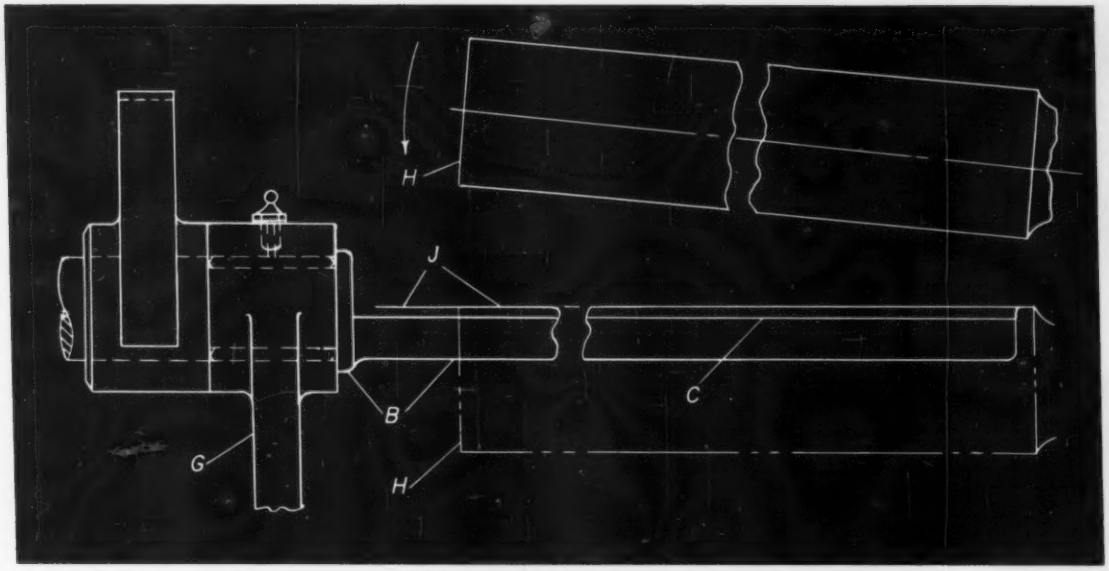


Fig. 2. Side view of bag-folding mechanism. Form (H) is shown just prior to and after entering position for folding.

rotation of blade *C*, blade *E* gains back the 18 degrees, and both blades complete the 180-degree working cycle simultaneously.

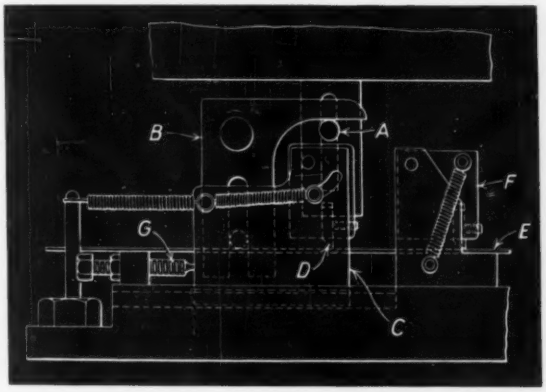
If standard gears were to be used, one gear would have to be retarded slightly to prevent interference between the folds. In this case, both blades would not hold the foil flat against the form at the end of the folding operation. In addition to foil, the device can be used to make bags of paper, cellophane, and similar materials.

An Intermittent Feed for Strip Material

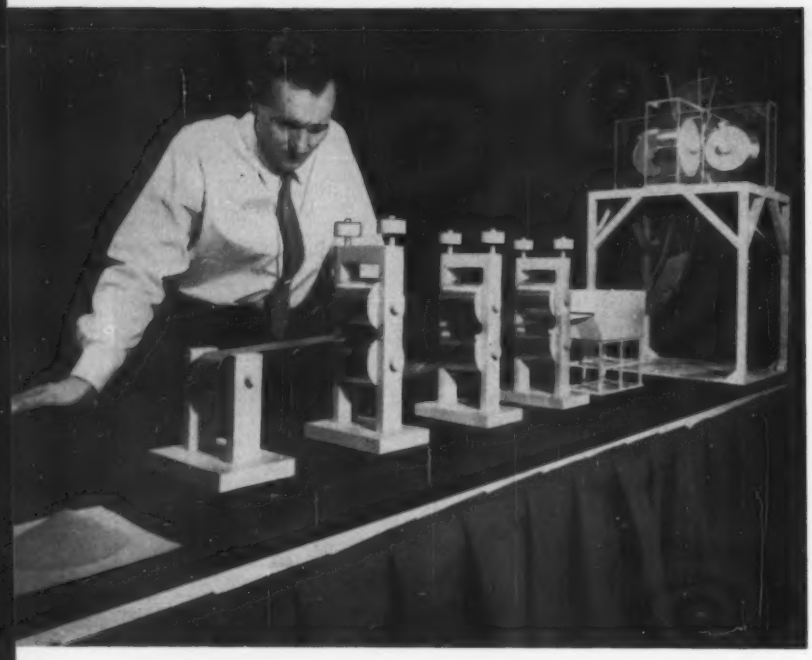
An arrangement for intermittently feeding the required length of strip material to a press is shown in the accompanying illustration. This patented mechanism is actuated by a pin *A*, which is attached to a slotted plate fixed to the bottom of the vertically reciprocating member of a press, or similar machine.

Pin *A* moves in the vertical plane and pivots a bellcrank *B*. This member, in turn, has an open-ended slot which engages with a pin projecting from one side of a sliding block *C*. Block *C* is guided and can only move in the horizontal plane. Thus, vertical movements of pin *A* produce horizontal reciprocation of the block. A pivoted holder and blade *D* are housed within block *C*, the blade being held in contact with the strip material *E* by means of a tension spring secured at one end to block *C*.

In operation, as pin *A* travels upward, block *C* moves to the right and, through the gripping action of the blade *D*, the strip material is fed in the same direction. A second spring-loaded and pivoted blade-holder *F* prevents the strip from moving back when block *C* is returned by an associated tension spring seen at the left in the illustration. An adjustable screw *G* limits the return movement of block *C* and the extent of the forward stroke is determined by the position of pin *A* in its slot, permitting the arrangement to be used for various sized parts.



A device for intermittently feeding lengths of strip stock to a die in a press.



Model shows the operating sequence of a new rolling process in which highly purified iron powder is turned into strip steel without melting. Iron powder is poured into a funnel, upper right, and is compressed into a semi-solid strip between four rolls. The strip passes through a furnace, then through a series of hot strip-rolling stands where it is reduced to the desired thickness and brought to full density.

Iron Ore to Strip Steel at Republic's Research Center

Republic Steel Corporation recently combined the dedication of its new Research Center in Independence, Ohio, with the introduction of a successful method for producing strip steel from iron ore, without melting. Budgets and schedules are set up on a "30-30-30-10" formula—that is, 30 per cent of the budget will be applied to research projects designed to show results in one to three years, 30 per cent will be applied to exploratory projects keyed to a five-year schedule, and another 30 per cent will be allocated to long-range study projects that may run ten years or more before paying off. This leaves approximately 10 per cent of the budget for pure science—fundamental research projects which have no immediate application, but which are expected to produce knowledge that will be useful at some future date.

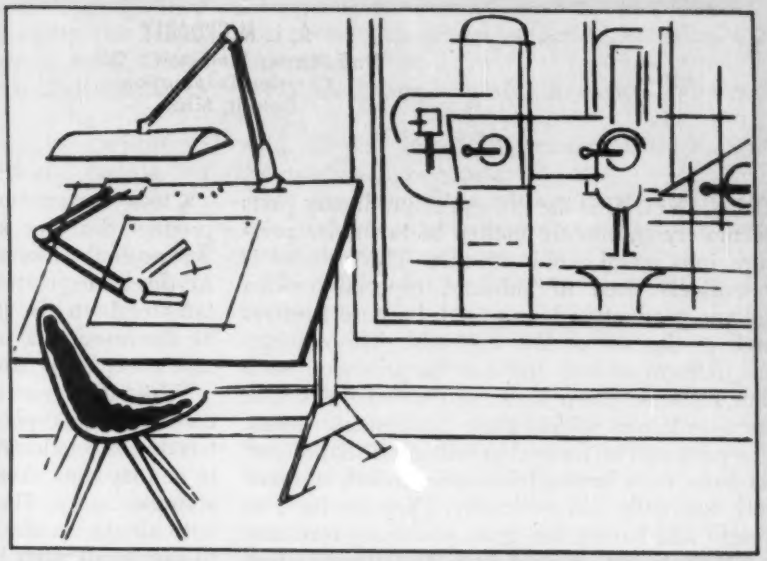
Work in the laboratories is divided into four broad sections: metallurgical, processing, new products, and ceramics. In the interest of flexibility and cooperation within and between the various groups, these divisions of work will not be hard and fast.

One development stemming from Republic's research efforts is a strip-steel rolling process which uses iron powder and bypasses the normally used coke ovens, blast furnaces, open hearths, and blooming mills. Although work on the process up to this time has been confined to the laboratory phase, a continuous pilot-plant line is to be set up to handle larger quantities of materials. Steel made in the laboratory is said to offer the same strength, ductility, and ability to be fabricated into finished parts as steel produced by other methods. More than 1800 pounds of metal has been made by the new process.

Three major steps are involved. First, iron ore is highly purified and directly reduced to metallic iron powder. Second, it is funneled between four rolls that compress it from a powder to a semi-solid strip.

Finally, the semi-solid strip passes through a furnace, is heated to 2200 degrees F. in a reducing atmosphere, then passes through a series of hot strip-rolling stands. This hot-rolling step reduces the thickness of the steel strip to the desired gage and brings it to full density. At the end of the line the hot-rolled steel is coiled. Following this, the steel goes through the usual operations of pickling, cold rolling, and annealing before being either re-coiled or cut into sheets.

MACHINERY'S *Reference Section*



WHAT THE DESIGNER SHOULD KNOW ABOUT PRODUCTION

PART 10—DIE-CASTING

AUGUST 1959

What the designer should know about production — Part 10

DIE-CASTING

A. L. McGROARTY
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Detroit, Mich.

DIE-CASTING is the process of producing parts accurately by forcing molten metal under pressure into metal molds or dies. The process is extensively used in industry, especially when volume production is required, because it offers high production at low unit cost. The castings are uniform in size and can be produced with thin sections, sharp lines, and cored holes that are maintained within close dimensional limits. The parts can be formed to unlimited shapes and contours, each having inherently smooth surfaces both internally and externally, They are light in weight and have a fine grain structure, resulting in a high strength-weight ratio. The process offers the possibility of combining several parts of an assembly, providing rigid and serviceable construction at low cost. Die-castings have relatively good corrosion resistance and excellent surface qualities for subsequent plating or painting.

Selection of the proper means of producing a specific part is governed by the application requirements of that part and the characteristic limits of the manufacturing process chosen. This can be determined by individual studies to find construction. Will the part lend itself to practical the most practical and economical method of die-casting? If so, what type of alloy can be used? Will the physical properties of the casting qualify, and will the production volume be sufficient to warrant die-casting? How will the tools and other manufacturing costs compare with those of alternate manufacturing methods? Table 1 may be helpful in making such a decision.

Designing for Die-Casting

The process of die-casting can be broken down into four phases: design, die construction, metal alloys, and production. How each of these phases contributes to the process as a whole should be understood.

Close cooperation is essential between the product designer and the die-casting engineer before final drawings of the part are prepared. At this time, certain characteristics and limitations of both the process and the material can be discussed and, in most instances, modified to save time, effort, and expense.

While it is generally agreed that an ideal die-casting is a simple one, this is not the current trend of the industry. It is now common practice to employ dies having twenty to thirty cores for a single cavity. These dies are usually designed with single cavities. However, it is not unusual to cast small parts having no cores in a die containing as many as fifty cavities, depending on the size, weight, shape, and castability of the piece involved.

Many methods can be employed to produce a die that is workable but not always of the best design. Experienced designers rely on facts generally unknown to the beginner. Although the following rules are intended to aid in designing die-castings, they can never be hard and fast in application. Generally, if followed wisely, they will go far toward achieving a logical design for simplicity and low cost.

1. Keep casting size at a minimum, consistent with other requirements, to reduce the cost of dies, work-pieces, and equipment.

2. All sections should be of minimum thickness, consistent with reasonable ease of casting and with adequate strength and stiffness. Thin sections are proportionally stronger than thicker ones, and frequently yield a smoother surface which is desirable for plating.

3. Make sections as nearly uniform in thickness as possible. Where variations are necessary, make a gradual transition from thinner to thicker sections.

4. Provide for cores wherever practicable. They save metal and machine work, result in

sounder castings, and tend to lower cost. The greater the number of castings required, the more important it is that cores be provided.

5. Cores can have a variety of shapes so long as they permit withdrawal from the casting. In general, cores are less costly and easier to operate when they lie parallel to the axis (direction of motion) of the die, or die-slide.

6. Avoid cores of extreme length, especially slender ones, unless they are completely justified by some special condition. Generally, the length of cores supported at only one end should not exceed three to four times their diameter, especially in sizes below 1/2-inch diameter.

7. Cores must be strong enough to withstand shrinkage stresses caused after the casting has solidified around them. Allow ample draft to facilitate their withdrawal.

8. Design castings to minimize flash removal. Flash always occurs at die partings and where joints in the die form crevices in the wall of the cavity, such as at slides and removable cores. If possible, avoid locating the parting line on significant surfaces.

9. Use fillets (as large as possible) at interior and exterior corners unless some special consideration requires that the corners be sharp.

10. Design the casting so that machining is minimized without undue sacrifice in accuracy, appearance, and performance.

11. Keep the shape of the casting as simple as conditions permit. To attain smooth surfaces for finishing, avoid large, flat surfaces. Curved areas commonly add to strength and stiffness, and, if polished, the highlights catch the eye and tend to mask surface defects.

12. Provisions may be made for ejector pins. Consult the die-casting engineer for location. If ejection is not permissible on any surface of the part, then other means for ejection can be provided outside the part and trimmed off in a subsequent operation.

13. Never specify tolerances closer than are essential.

14. Allow ample draft on cavity walls and cores.

15. Employ integral fastening parts wherever their use will lower assembly cost.

16. Avoid undercut castings that require movable cores, except where the advantages outweigh the disadvantages.

17. Employ inserts wherever their use results in economy.

Some of the aforementioned points to be considered in designing parts to be die-cast are illustrated in Figs. 1 to 4. In each of these illustrations the detail drawings at the right show the preferred designs. As seen at top in Fig. 1, sharp interior corners should be avoided if at all possible, since they are difficult to maintain and may cause cracking or structural weakness. It is desirable to provide a fillet or recess having a radius of at least 0.010 to 0.015 inch. Also, a recess should be specified where sharp corners

Table 1. Relative Ratings of Different Casting Methods with Respect to Various Factors

FACTOR	RELATIVE RATING*					
	CASTING METHOD					
	Sand	Plaster Mold	Centrifugal		Permanent Mold	Die-Casting
	MOLD MATERIAL					
	Sand	Plaster	Sand	Metal	Metal	Metal
Porosity	6	4	2	1	3	5
Surface Finish	6	1	5	3	4	2
Tolerances	6	2	5	3	4	1
Strength of Solid Metal	5	5	4	2	3	1
Thin Sections	6	1	5	3	4	2
Production Rate (Small Runs)	1	5	4	2	3	6
Production Rate (Large Runs)	5	6	4	2	3	1
Reduction in Machining	5	1	4	2	3	1
Cost per Piece	5	6	4	2	3	1
Tool Cost	1	3	2	4	4	5

* Relative Ratings: 1 represents the best, and 6 the poorest.

on two castings must fit together, as seen at the right, center. Maximum possible radii should be provided on outside corners and fillets, as well as those on the inside of the casting (bottom view).

Cored through-holes that are to be tapped should be countersunk at both ends as illustrated at the top, right, in Fig. 2. Cored holes should not be deeper than three times the diameter and should be either at right angles to, or parallel with, the parting line. The removal of burrs and flash from inner surfaces of the die-castings can be simplified by recessing the flash seam (center). Thin walls in the casting die around cores can sometimes be avoided by designing the part as seen at the bottom, right.

Shown at the top in Fig. 3 is one method of avoiding thin cast sections that are difficult to fill. In this instance, a shallower hole (right) was specified. Expensive die construction is necessary for parting on work-pieces having sloping bosses as seen at the left, center. This can be overcome by modifying the product design (right, center) to permit straight die parting. The bottom views illustrate a modification in cavity design to eliminate binding due to shrinkage over the cores.

Interlocking cores, as shown in the die-casting at the upper left in Fig. 4, should be avoided whenever possible. In the preferred design at the upper right, two small cores bear against the larger, vertical one. The need for side cores can often be avoided by designing the hole as seen at the right, center. Easier ejection of die-castings having deep ribs is permitted by allowing maximum draft on the ribs (bottom, right). Although ample draft is recommended, a minimum draft of 1 degree on inner surfaces and 1/2 degree on outer surfaces should be provided to facilitate ejection.

Wall sections should be as uniform as possible. However, where heavy sections of the die-casting are cored to obtain uniform wall thicknesses, it is sometimes necessary to add ribs for strength requirements. Also, ribs are often desirable on bosses. A minimum flat of 0.030 inch should be provided at the parting line for gating and trimming. Whenever feasible, all of the deep cavities should be on one side of the die-casting. Moving cores that must fit accurately on both die halves should be avoided. The same results can often be obtained by subsequently drilling the required holes in the casting.

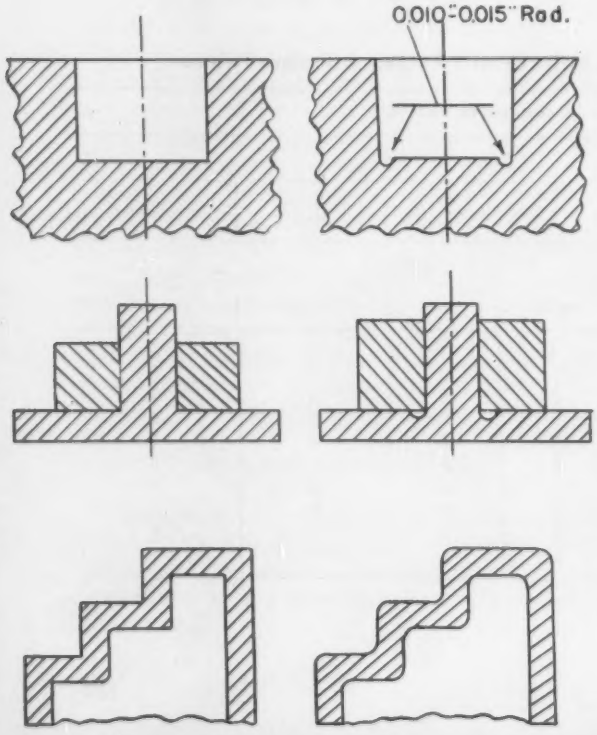
To prevent flash from forming in the threads of inserts, an unthreaded portion of the insert shank should be provided between the face of the casting and the threads. Large plane surfaces should be avoided wherever possible by interrupting such areas with ribs, serrations, or stippling. Casting of drill spots is often preferred to coring through holes. Subsequent off-hand drilling from such locating spots is simple. Thick sections promote porosity and slow the production rate. However, thin sections (which should not be less than 1/16 inch) are difficult to fill, and should be blended into heavier sections. A section thickness of 1/8 to 1/4 inch generally provides the best combination of castability and strength.

Tolerances should never be specified closer than are essential unless they are limits commonly held in die-casting the alloy to be used. Approximate dimensional limits for die-casting with various alloys are given in Table 2.

Means for fastening are made an integral part of the die-casting whenever assembly costs can be lowered in this way. If the material being cast is sufficiently malleable, solid or hollow projections can be cast and then riveted at assembly. In other cases, stud or pin projections are cast to receive fastening devices. For example, the die-cast trim strip seen in Fig. 5 has integrally cast studs over which fastening clips are provided to snap into holes in the sheet metal part.

Casting and polishing of the one-piece, chromium-plated knob shown at the top in Fig. 6

Fig. 1. Rounded corners or fillets should be provided on both inner and outer surfaces of die-castings, as seen in the views at right. Poor designs are shown in illustrations at the left.



was expensive. Production costs were cut by changing to a two-piece riveted construction shown below. The die-cast lamp housing seen in Fig. 7 includes an integrally cast bulb socket which is turned over to form the spring seat.

Inserts can be employed wherever their use results in economy, or to secure results that cannot be realized by other means. Knurled bushings and a reinforcing plate are cast into the part shown in Fig. 8 to provide increased strength. The preferred method of providing for threaded inserts is to core a hole to tap drill size and then tap the hole and drive the insert. Another method is to drive the insert into an untapped hole of the proper size, in which case, the diameter of the boss on the casting should be at least twice that of the insert. Also, the length of engagement should be at least one and one-half times the stud diameter. More costly methods of casting threaded inserts in place are illustrated in Fig. 9.

Wherever possible, all lettering or numbering should be cast with ample draft on the underneath surfaces of the part. Raised letters are most economical, as they may be engraved or sunk with punches in the die. When characters must appear on finished surfaces, they should be flush with the adjacent surfaces to permit easy polishing and preservation of the characters. This can be accomplished by a debossed engraving in the die, or they may be added with a stamping die in a separate operation.

Die Construction

Designing of die-casting dies is a highly specialized branch of the design field requiring intimate knowledge of the many production problems. The designer must be especially well-versed in pattern allowances to produce castings of proper size, shape, and contour. He should:

1. Know the shrinkage and contraction characteristics of the metal alloys to be cast.
2. Allow for shrinkages and distortions of cavities and dimensional changes after the casting cools to normal room temperature.
3. Establish proper parting lines, wall thicknesses, tolerances, and drafts.
4. Locate gating, lugs, ribbing, and cores.
5. Establish integral fastening provisions to reduce assembly cost.
6. Minimize flash and the cost of removing it.
7. Reduce the need for secondary machining work to lower costs.
8. Eliminate causes of porosity.

A large number of casting dies are designed with a single cavity, but when parts favorable in size and shape are required in large quantities,

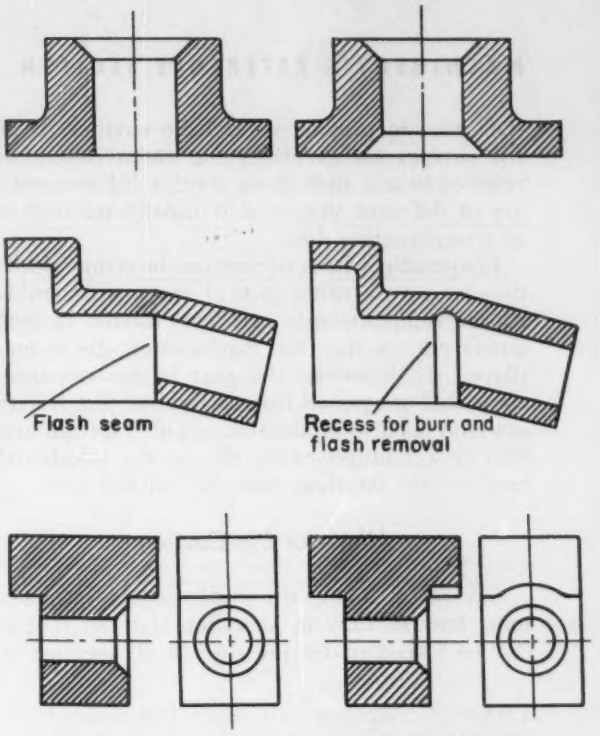


Fig. 2. Other desirable design features include countersinking both ends of holes to be tapped (top, right), recessing for burr and flash removal (center), and avoiding thin walls around cores (bottom).

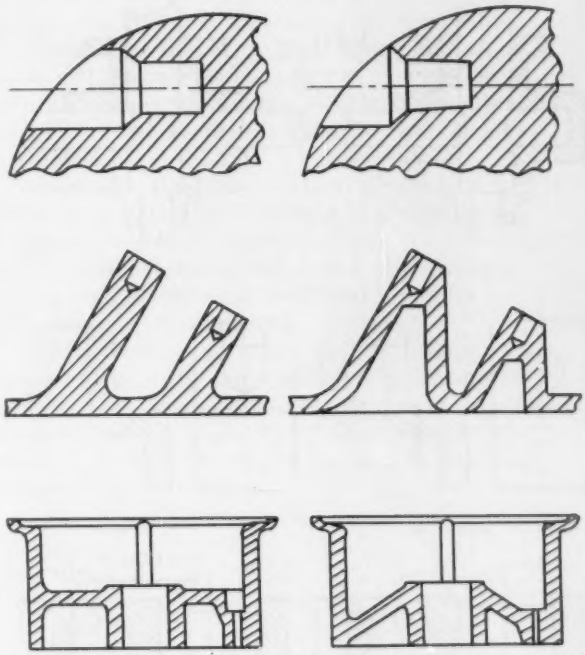


Fig. 3. Shallower hole (top, right) avoids thin cast section. Modified design of casting seen at center permits straight die parting. Cavities in casting at bottom were redesigned to eliminate binding.

it is wise to provide several die cavities. If all the cavities are identical, the die is commonly referred to as a multiple-cavity die. If the cavities are of different shapes, it is usually referred to as a combination die.

Frequently, when one part can be economically die-cast, several other parts of the same assembly can be simultaneously cast. It is usually in such circumstances that the combination die is employed. If, however, the part is one requiring cores that are pulled from several angles, it may not lend itself to production in either a combination or a multiple-cavity die as the additional cavities may interfere with the moving parts.

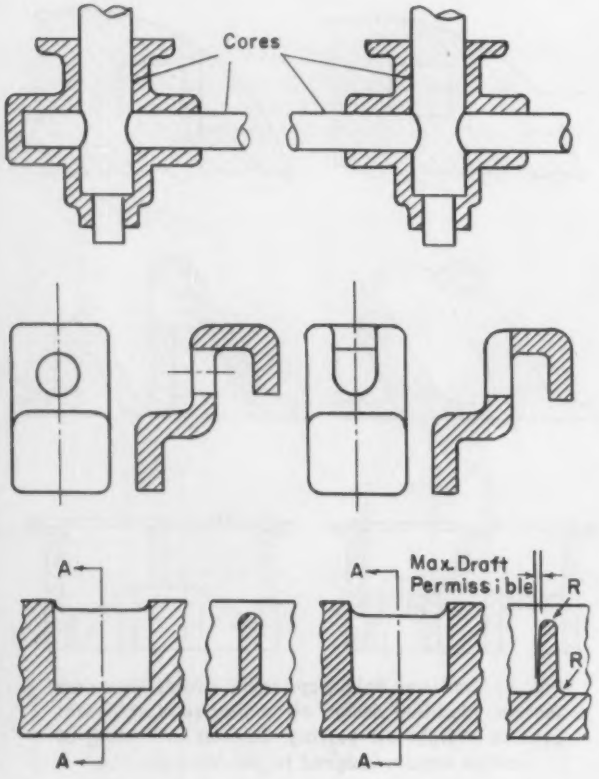
Alloys for Die-Casting

Any metal intended for die-casting purposes must flow steadily in a molten state so that it can be forced under pressure to all sections of the die cavities. There are six basic casting alloys, each having various grades and formulas. Because some grades have better casting qualities than others, the choice of formula should always be the simplest for the need. Following is a list of the six alloys, their approximate melting temperatures, and average weights.

Alloy	Approximate Melting Temperature, Degrees F.	Average Weight, Pounds per Cubic Inch
Tin	417	0.27
Lead	484	0.36
Zinc	727	0.24
Aluminum	1115	0.097
Copper	1600	0.307
Magnesium	1110	0.066

Each alloy has its purpose. The lower the melting temperature, the easier to die-cast. Some alloys have higher tensile strengths, while others are more corrosion resistant and possess better finishing qualities. To follow are brief descriptions of the basic alloys and their applications.

Fig. 4. Interlocking cores (upper left) can sometimes be avoided by having shorter cores bear against a larger one (upper right). Maximum draft should be provided on deep ribs (bottom, right) for easy ejection.



Tin- and Lead-Base Die-Casting Alloys

Tin- and lead-base alloys have only minor uses in die-casting because of their low tensile strength. Tin-base alloy has excellent corrosion resistance and can be used in contact with food and beverages. It has a low melting point (417 degrees F.) and is easy to cast. Tin has a very small shrinkage reaction in cooling and is therefore desirable for accuracy. It has good bearing qualities, but is not generally adaptable for high-stress machine parts because of its low short-time tensile strength of 8000 to 10,000 psi.

Lead-base alloy can be used when resistance to sulphuric acid or other chemicals is a concern. Occasionally, lead castings are used for bearing purposes. However, they have a tendency to deform under load, having relatively low strength, hardness, and impact resistance. Although heavy, the alloy is not suitable for use at elevated temperatures because of its low melting point (about 484 degrees F.). Its fluidity can be improved by the addition of tin. The nominal composition of lead-base alloy is as follows:

Constituent	Percentage
Antimony	8.0 to 9.5
Tin	1.0 to 1.75
Arsenic	0.75 Max.
Others	0.50 Max.
Lead	Balance

Lead has a short-time tensile strength of 10,000 to 14,000 psi. Alloys of both tin and lead are more expensive than those of zinc, aluminum, and

Table 2. Approximate Dimensional Limits for Die-Casting with Various Alloys

	ALLOYS		
	Zinc	Aluminum and Magnesium	Copper (Brass)
Minimum wall thickness, large castings, inch	0.062	0.085	0.125
Minimum wall thickness, small castings, inch	0.030	0.050	0.050
Minimum variation from drawing dimensions, inch per inch of length or diameter*	0.001	0.002	0.003
Maximum number of external cast threads per inch	24	20	10
Maximum number of internal cast threads per inch	24†	0	0
Minimum diameter of cored holes, inch	0.030	0.093	0.187
Minimum draft, inch per inch of length on cores and side walls	0.005	0.005	0.020

* Applies only to dimensions between points formed by solid portions of the die. When the dimension is across the parting line or between points controlled by parts of the die having relative motion, wider limits must be allowed.

† If less costly than tapping. Fine internal threads are usually tapped.

magnesium; hence they usually yield to the less costly alloys for the most common applications.

Zinc-Base Die-Casting Alloy

Applications of zinc die-castings seem almost endless. They are low in cost and have excellent physical properties at normal temperatures. Commercial zinc alloys have good strength and ductility and are highly resistant to shock.

Zinc is the best mass-production alloy—its production rate ranging up to 600 die shots per hour, depending on the piece size, shape, and the cooling qualities of the die. Small machines have been developed to cast at the rate of 1000 shots per hour, but their application is limited. The melting temperature of zinc is 727 degrees F., making it easy to cast with very little wear and tear on the dies. It has a short-time tensile strength of 41,000 to 47,000 psi.

Zinc alloy is extremely sensitive to the effect of tin, lead, and cadmium, which must be kept to a few thousandths of 1 per cent to prevent structural deterioration. Following is the nominal composition of the alloy.

Constituent	Percentage
Aluminum	3.5 to 4.3
Magnesium	0.03 to 0.08
Copper	0.75 to 1.25
Zinc (99.99 per cent pure)	Balance

Aluminum-Base Die-Casting Alloy

Aluminum-base alloy must be handled and cast differently from lower melting temperature alloys, since it will deteriorate the iron in the equipment and tools. For example, gooseneck, nozzle, plunger, and metal pots (as used for zinc casting) will deteriorate if permitted to remain in the molten metal for too long a period of time. Metal is melted, therefore, and held in an auxiliary furnace separate from the die-casting machine. It is then either manually or automatically ladled into the cold-shot chamber, from which it is forced into the die cavities. Aluminum, which melts at 1115 degrees F., is cast at a much slower rate than are the lower melting temperature alloys. A good average is from 50 to 125 shots per hour.

Aluminum alloy has certain advantages for die-casting. Although it is light in weight, it has comparatively high tensile strength. Also, it has good resistance to corrosion and the ability to take a high polish which will hold up under normal atmospheric conditions.

A disadvantage in using aluminum-base die-casting alloy is the high casting temperature required. This causes high die-repair costs due to erosion and heat checking. Short-time tensile strength is 35,000 to 41,000 psi, and its nominal composition is as follows:

Constituent	Percentage
Copper	3.5
Silicon	5.0 to 12.0
Magnesium	0.0 to 0.05
Aluminum	Balance

Copper-Base Die-Casting Alloy

Copper-base die-casting alloy possesses superior properties in regard to strength, impact resistance, and non-corrosive qualities. Because of its

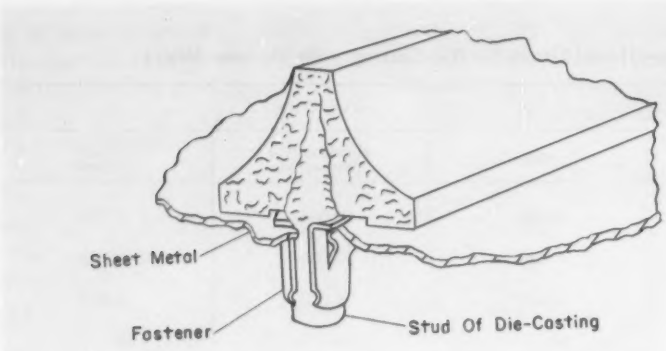


Fig. 5. Fastening clip is snapped onto integrally cast stud of trim strip to hold sheet metal in place.

high melting point (approximately 1600 degrees F.) it is cast, like aluminum, in a cold-shot chamber. The extreme heat factor makes casting very hard on dies. Cost becomes prohibitive, especially if the cavities are complicated and expensive. Special high-alloy steel is used for die construction, which also adds to the expense.

Generally, copper is the most difficult alloy to cast. It requires large-size die-casting machines because it needs high injection pressures.

The impact strength of a copper die-casting is actually greater than that of a sand casting made of the same alloy and, in most instances, it is equal to that of a forging. Also, copper castings have excellent machinability. Their short-time tensile strength is 45,000 to 55,000 psi. Due to its weight, slow casting methods, and extreme die-maintenance cost, the use of copper is impractical in most cases. Nominal composition is:

Constituent	Percentage
Copper	57.0 to 85.0
Silicon	0.0 to 4.5
Zinc	Balance

Magnesium-Base Die-Casting Alloy

A major advantage of magnesium alloy is light weight—it is approximately two-thirds as heavy as aluminum and one-fifth as heavy as brass. In addition, magnesium is easily machined, has high dimensional stability, and possesses non-magnetic and non-sparking qualities.

Although magnesium is susceptible to fire mishaps, the dangers are somewhat exaggerated, and, if handled with reasonable caution, they can be eliminated. Special precautions are taken to prevent rapid oxidation of the molten metal while casting. It is kept under a flux and in a hood filled with sulphur dioxide gas until ladled into the cold chamber for the shot. Magnesium is cast at a temperature of 1110 degrees F.

One disadvantage of a magnesium-base alloy is that it has a low corrosion resistance in salt water or high tropical humidity. It is, however, satisfactory for most any outdoor exposure if a protective coating is applied. Magnesium has a short-time tensile strength of 32,000 psi and a nominal composition as follows:

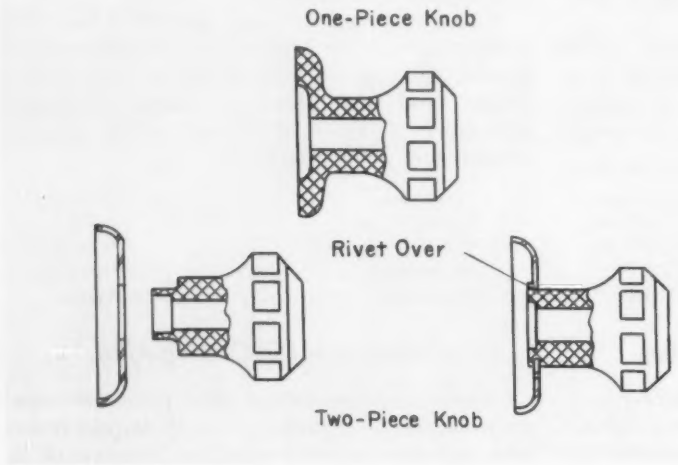


Fig. 6. A two-piece knob (bottom) is less expensive to cast and polish than the one-piece design (top).

Constituent	Percentage
Aluminum	9.0 Max.
Manganese	0.10 to 0.13
Zinc	0.70 Max.
Magnesium	Balance

The relative ratings of four different die-casting alloys with respect to mechanical properties, physical constants, casting characteristics, and cost are given in Table 3.

Production and Finishing of Die-Castings

Die-Casting Equipment—All die-casting machines are constructed to operate on either of two principles, or both. One type, called a hot-chamber machine, is built with a metal feed and melting furnace as part of the equipment. Metal is forced by a plunger through a gooseneck (inserted in the furnace) to a nozzle and then into the die. The operation functions semi-automatically during a shot cycle.

In the other type, called a cold-chamber machine, the metal is ladled from an auxiliary holding furnace into a cold injection chamber. Here, a plunger injects the molten metal into the dies. Some machines are built to satisfy both functions, but require changing of feeding apparatus for each type of operation.

The semi-automatic machines are built to handle metals, such as zinc alloy, whose melting point does not exceed 850 degrees F. Aluminum, magnesium, and copper alloys are cast by the slower cold-shot method because they have a much higher melting point.

Secondary Machining—Since parts are usually die-cast to very close tolerances, any further work is generally limited to light machining or to finishing operations. Secondary machining may involve drilling, tapping, piercing, or countersinking of holes and possibly may entail hand scraping, filing, sanding, tumbling, and blasting to deburr or remove flash. It may also involve turning, boring, or milling. Sometimes assembly operations such as spinning, riveting, bolting, and grooving are performed. Because of the quantities involved, secondary machining often lends itself to automation.

Polishing and Buffing—Polishing and buffing are kindred operations that are usually considered as one function. Polishing is a flexible grinding process for smoothing a surface. Cutting is performed by abrasive particles adhering to the surface of resilient wheels which are made of wood, felt, leather, canvas, or fabric.

Buffing is the process of smoothing and bright-

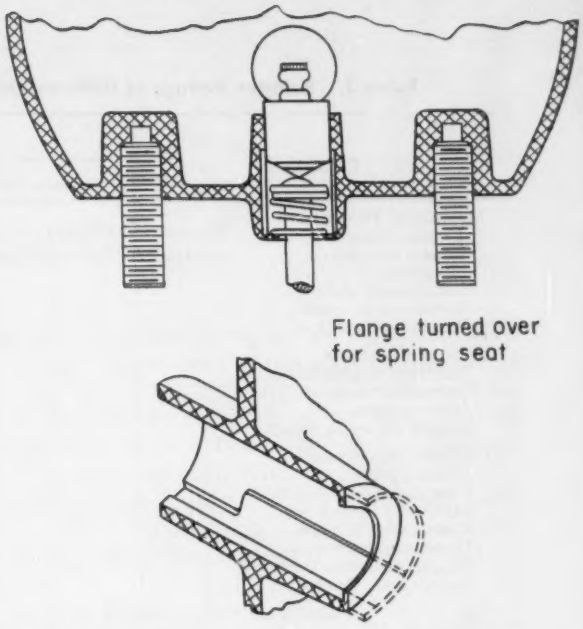


Fig. 7. Bulb socket is an integral part of this die-cast lamp housing. Flange is turned over to form seat.

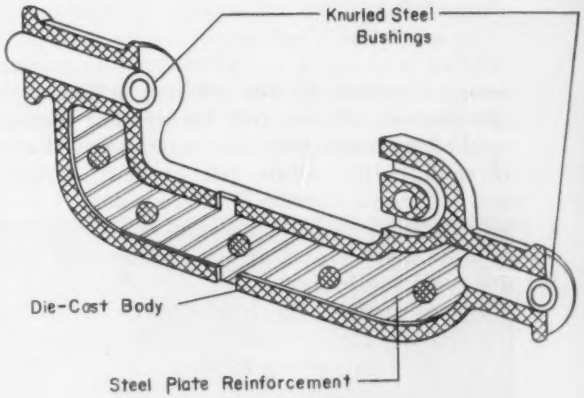


Fig. 8. Increased strength is obtained in this frame by casting knurled bushings and plate into the part.

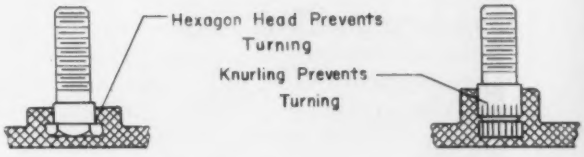


Fig. 9. Threaded inserts can be provided with hexagonal or knurled heads to prevent turning in die-casting.

Table 3. Relative Ratings of Different Die-Casting Alloys with Respect to Various Factors

FACTOR	RELATIVE RATING*			
	Aluminum Alloys	Magnesium Alloys	Copper Alloys	Zinc Alloys
Mechanical Properties				
Tensile strength	3	4	1	2†
Impact strength	3	3	1	2†
Elongation	3	4	1	2†
Dimensional stability	2	3	1	3
Resistance to creep	2	2	1	3
Brinell hardness	3	3	1	2
Physical Constants				
Electrical conductivity	1	4	3	2
Corrosion resistance	3	4	1	2
Melting point	2	2	3	1
Weight per cubic inch	2	1	4	3
Casting Characteristics				
Melting point	2	2	3	1
Ease and speed of casting	2	2	3	1
Maximum feasible size	1	1	2	1
Complexity in shape	1	1	2	1
Dimensional accuracy	2	2	3	1
Minimum section thickness	2	3	4	1
Surface smoothness	2	2	3	1
Cost				
Die cost	2	2	3	1
Speed of production	2	2	3	1
Die life	2	2	3	1
Finishing cost	3	3	2	1

* Relative Ratings: 1 represents the best, and 4 the poorest.
† These are short-time comparatives. Zinc will creep at room temperature.

ening a surface by the rubbing action of fine abrasives in a lubricating binder. The binder is applied intermittently to a moving wheel made of wool, cotton, fabric, felt, or cloth. Polishing and buffing production lines are generally set up for a progression of operations starting with polishing with coarse grit and graduating to fine grit, followed by buffing.

Electroplating—Electroplating of die-castings is a process in which various metals are deposited to obtain a decorative finish, or a finish that is more resistant to destructive elements. The plating may be chromium, nickel, copper, brass, silver, gold, or of other types.

It is desirable that all die-castings be given a surface-conditioning treatment before electroplating. The parts are immersed in a warm zinc-sulphate solution and agitated slightly for a period of three to ten minutes. They are then given two water rinses to prepare them for plating. The process removes all oxide from the surface of the casting and replaces it with a thin, metallic zinc coating. All further applications of various metals by electroplating will then adhere to this zinc coating.

Painting—In the face of greater competition, final surface finish is taking on more importance in the sale of products. Painting, in its modern variety of attractive colors, has added appeal and is replacing some of the more expensive surface finishes. The automotive industry is particularly interested in painting because it saves time and lowers costs.

There are three methods of painting: Brush dip, and spray. Large pieces are usually sprayed or brushed; smaller pieces are dipped. Following a standard degreasing operation, the product receives a priming or sealing treatment so that paint will adhere.

Anodizing—Anodizing is a process resulting in the anodic oxidation of non-ferrous metals to make a surface weather and corrosion resistant. As in plating, the quality of work depends on the condition of the surface prior to application.

From the foregoing it is evident that die-casting manufacture is not one, but several specialized techniques combined to turn out a finished product. The process embodies tool design, tool making, metallurgy, casting, trimming, secondary machining, polishing, buffing, plating, painting, anodizing, and extensive material handling. Die-casting is not only versatile, but has been described as the shortest distance between raw material and finished product.

MATERIALS

The properties and new applications of materials used in the mechanical industries

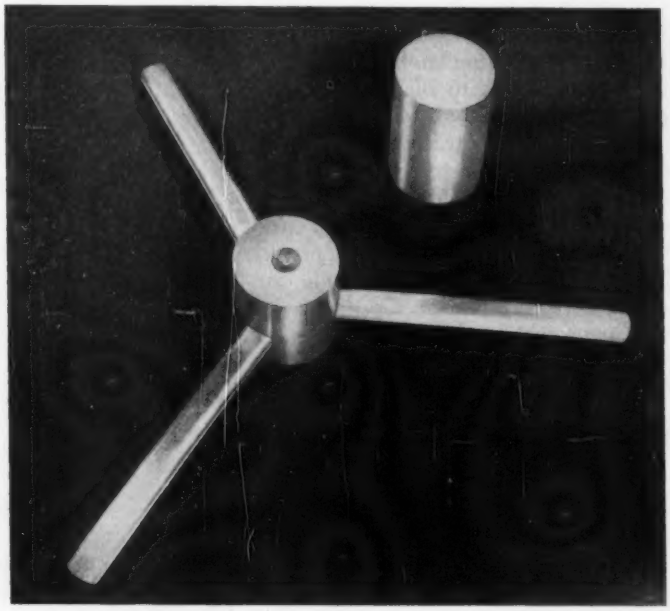
Titanium-Alloy Tubing Combines Ductility with High Strength

A ductile, high-strength titanium alloy has been made available in the form of small tubing by Superior Tube Co., Norristown, Pa. The alloy, known as "3 A1-2.5 V titanium alloy," has applications in aircraft and missile parts where a metal having a high strength-to-weight ratio and corrosion resistance is required. Annealed tubing made from the alloy has a yield strength of 85,600 psi. In the full-drawn condition, it has a yield strength of 118,000 psi. The alloy will take cold flaring up to 35 per cent without cracking, and its elongation properties compare with those of unalloyed titanium.

Tubing made from the alloy can be obtained in the ductile annealed condition for easy fabrication and then heat-treated to a high strength. Strength of the heat-treated tubing stands up well at elevated temperatures. The tube is furnished in seamless form in diameters from 0.012 inch to 1.125 inches, the maximum and minimum wall thickness depending upon the size. Nominal chemical composition of the alloy in percentage is aluminum 3.0, vanadium 2.7, silicon 0.02, iron 0.16, manganese 0.01, carbon 0.02, nitrogen 0.015, hydrogen 0.011, and the balance, titanium. It has a melting point range of 3000 to 3250 degrees F. and a density of 0.162 pounds per cubic inch. Young's modulus of elasticity for annealed tubing at room temperature is 15,000,000 psi.

Versatile Cleaner Preconditions Steel for Painting

An acidic detergent which combines good cleaning and prepaint-conditioning properties has been introduced by Oakite Products, Inc., 126 Rector St., New York 6, N. Y. The new material, "Oakite Compound No. 86," simultaneously cleans steel and improves both its resistance to corrosion and receptivity to paint. It is particularly useful as a precleaner to improve phosphate coatings. In addition, it is an effective cleaner for brass, aluminum, zinc, and terne plate.



A metal-working technique, called lateral impact extrusion, has been developed by Aluminum Company of America, 1501 Alcoa Bldg., Pittsburgh 19, Pa. Here, shown with the slug from which it is produced, is the prototype aluminum impact made by the company. The entire part—hub and spokes—is produced in one stroke of an impact press. This part illustrates the possibility of metal flow outward from the direction of the press stroke, in addition to conventional forward and reverse flow. The impact process essentially combines forging and extrusion to produce intricate close-tolerance products having forged strength.

The compound is recommended for use in spray washing machines, in a three-stage operation. These stages include first a cleaning and conditioning of the parts in Oakite Compound No. 86, 2 per cent by volume in water solution; then an overflowing rinse; and finally an acid rinse. The product may also be used in tank immersion operations.

Alloy that Resists Corrosion at High Temperatures

A nickel-base alloy, called "Hastelloy Alloy N," is being produced on a developmental basis by Haynes Stellite Co., division of Union Carbide Corporation, 420 Lexington Ave., New York 17, N. Y. First produced as a container material for molten fluoride salts, the alloy resists the corrosive effects of fluorides at high temperatures. It is also resistant to embrittlement upon continuous exposure to temperatures up to 1600 degrees F. Tests have shown the alloy to have sufficient oxidation resistance in air for continuous use at 1800 degrees F.

The product has good weldability and can be readily forged, its hot-working range being between 1600 and 2150 degrees F. The alloy has been extruded and produced in the form of seamless and welded tubing. It can be supplied to order, in the form of sheet, plate, bar, wire, coated welding electrodes, and sand, shell, and investment castings.

Process for Bonding Carbide to Steel

A process for joining cemented carbide to steel (or other metals) has been announced by the Powder Alloys Corporation, 316 Colfax Ave., Clifton, N. J. An alloy called "Plymet," produced in the form of thin wafers, is used to make the bond. The bonding method can be used to attach carbide tips to blanking punches, molding punches, turning tools, drills, and other tools.

In bonding, the wafer is inserted between the carbide tip and the steel member to which the tip is to be attached. Pressure of about 500 psi is applied to the joint as it is heated either by acetylene torch or induction coil to between 1900 and 2000 degrees F. for approximately one minute. A diffusion of the interfaces of the carbide-Plymet-steel combination takes place, making the bond. Shock-resistant joints with rupture strengths of from 100,000 to 135,000 psi are produced.

Teflon Tape for Sealing Pipe Joints

A pipe joint sealer made in tape form from Teflon has been introduced by the Crane Packing Co., Dept. MY-3, 6400 Oakton St., Morton Grove, Ill. Known as "Thred-Tape," the product can be used to seal all types of threaded connections in piping for most industrial acids, corrosives, caustics, hydraulic fluids, and aromatic fuels. It is also recommended for piping handling alkalies, toxics, biological materials, and gas. The product is effective at temperatures ranging from minus 250 to plus 500 degrees F. and at pressures to thousands of pounds.

Useful on plastic, aluminum, stainless steel, ceramic, synthetic rubber, and carbon pipe, the tape prevents seizing and galling, is self-lubricating, and allows connections to be drawn up tight. It never hardens, thus permitting easy disassembly of joints. Available in 1/2- by 288-inch rolls, the tape is applied by wrapping it tightly around the male threads. When the connection is made, the tape fills the voids to provide a seal.

High-Strength Adhesives that Bond Many Materials

Two high-strength epoxy bonding agents have been made available by the Chemical Development Corporation, Danvers, Mass. Called Cepox 401 and Cepox 402, the new adhesives are useful for cementing cast iron, steel, copper, aluminum, bronze, brass, plastics, and other materials to themselves or to each other. In addition, the products are employed to seal and fill gaps.

The adhesives are thermosetting and produce a tough, water-insoluble bond that resists most acids, alkalies, and other chemicals. According to the manufacturer, they have high impact, tensile, shear, and compressive strength and will not dry out, crack, or deteriorate with age. The products contain no solvent or diluent. Cepox 401 produces a tough, rigid bond, while Cepox 402 produces a strong, flexible bond with high peel strength. Both adhesives require no heat or pressure for curing.

Alloy of Magnesium and Rare-Earth Metal for Missile Use

An alloy containing magnesium and a rare-earth metal has been developed by the Dow Chemical Co., Midland, Mich., for missile applications. Sand castings made of the new alloy, designated EK31XA, are being produced for evaluation purposes. The company claims that the castings have good tensile strength at room temperature and at elevated temperatures up to about 600 degrees F. They also have good creep resistance when exposed to these elevated temperatures for periods up to ten hours. When the castings are exposed to elevated temperatures for a long term, their properties, including creep strength at up to 1000 hours exposure, show the product to be serviceable to about 450 degrees F.

The alloy has good castability, can be welded by argon-arc or Heliarc methods, and can be fin-

ished with standard magnesium finishing systems. It also is a good forging alloy. Composition of the alloy is 3.2 per cent rare-earth metal didymium, 0.6 per cent zirconium, and the balance magnesium.

Coating for Masking Machined Surfaces Before Pickling and Plating

A coating for masking metal surfaces has been developed by Consolidated American Services, Inc., 9999 Jefferson Blvd., Culver City, Calif. The product, called CMS-N-202, allows machined or polished surfaces to be protected during pickling and passivating operations. It can also be used to mask areas of parts not requiring plating, the coating being effective in most plating solutions.

The product, which is black in color, can be applied by any conventional method including brushing, spraying, and dipping. It requires no mixing or additives and can be removed easily.

Liquid Sealant for Securing Metal Parts

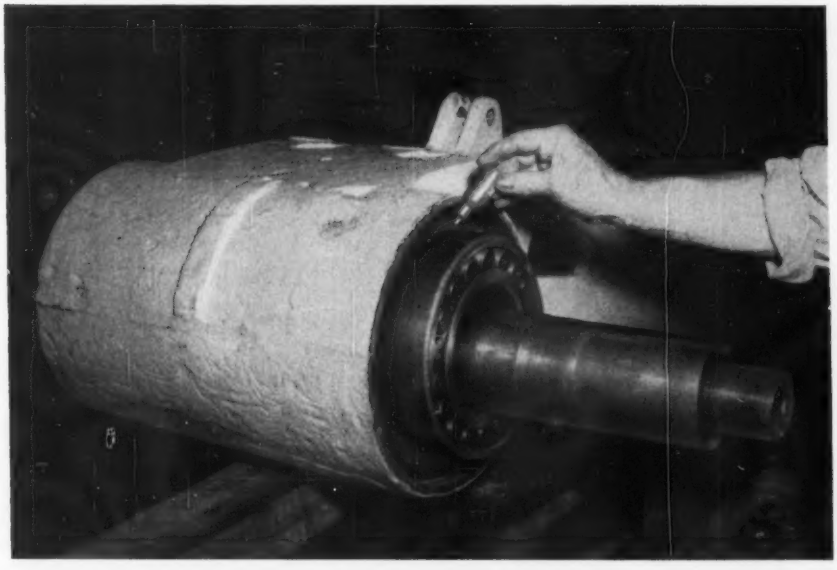
"Loctite," a thin liquid plastic sealant, has been made available by the American Sealants Co., Woodbine St., Hartford 6, Conn. The liquid hardens only when confined between closely fitting metal parts. A catalytic action caused by the metal surfaces and aided by the absence of air hardens the sealant into a heat- and oil-resistant bond. Joints are impregnated with solid plastic because the sealant hardens by polymerization and is non-shrinking. The product, being fully prepared, requires no mixing or heating. As shown in the accompanying illustration, the sealant can be employed to retain bearings in housings. It can also be used to lock nuts and bolts, to seal threaded and sleeve joints on shafts, and to mount bushings without a press fit.

Abrasive-Impregnated Nylon Web for Finishing Metals

A material for finishing fabricated metals is being produced by Minnesota Mining & Mfg. Co., Dept. F9-184, 900 Bush Ave., St. Paul 6, Minn. Called "Scotch-Brite" brand finishing material, the product is made of nylon web impregnated with fine grades of abrasive. It is not intended for stock removal. In addition to use in finishing stainless steel and aluminum, the material can be employed on zinc, brass, copper, titanium, and other non-ferrous metals.

Typical applications include the finishing on a production basis of aluminum extrusions, die castings, tubing, forgings, stampings, and sheets; zinc die castings; brass tubing; copper sheets; and stainless sheets and jet blades. It can also be used prior to and during pickling operations. The material is suitable for automatic, semi-automatic, and hand operations, and can easily be used in portable tools. Finishes generated at the mill or during fabrication that are damaged slightly or scratched in shipping and assembling can be blended on-the-job with the product.

Supplied in disc form, the material is about 1/4 inch thick. Five discs make a loading approximately 1 inch wide. The discs can be ganged on a spindle to any width, with the widest commonly used being that for finishing 60-inch steel sheet. Available in 6-, 8-, 10-, 12-, and 14-inch diameter, the discs are produced in four types: very fine, fine, medium, and coarse. The material is also made in sheets and rolls.



Here, "Loctite," a liquid sealant, is being used to retain a 9-inch spherical roller bearing replaced in the jaw of a rock crusher at the Acme Road Machinery Co., Frankfort, N. Y.

Fig. 1. Operator prepares to lower cutting heads of a 43-foot-high vertical boring mill which machines high-pressure inner shells for steam turbine-generator units. The cylinder protruding from the spindle end is a closed-circuit television camera. It transmits a picture of cutting action to a screen on the operating bridge and enables the operator to follow the tool when it is as far as 8 feet from him.

Advanced Machine Tools for Large Turbine-Generators

General Electric Co.'s Large Steam Turbine-Generator Department in Schenectady, N. Y., recently unveiled a multi-million-dollar array of advanced machine tools, many numerically controlled, that will be used to perform such varied tasks as drilling thousands of holes in 90-ton generator rotors and contouring steam-turbine buckets to shapes never before possible. Embodying the latest ideas in machine design and manufacture, they have been placed in service to help meet anticipated future demands of the electric utility industry for giant powermakers. All of these new tools utilize advanced manufacturing techniques to help build steam turbine-generators with ratings of 50,000 to more than 500,000 kw.

One of the new installations is a Morton vertical stub-bar boring mill, Fig. 1, for machining both the inside and outside of steam-turbine

Fig. 2. Cutting head can be seen at the left on this profile miller for large turbine buckets. More than 5000 buckets ranging in length up to 72 inches are used in a typical large steam-turbine unit. Three-dimensional milling is done completely around bucket, cutting it to dimensions for grinding and polishing.

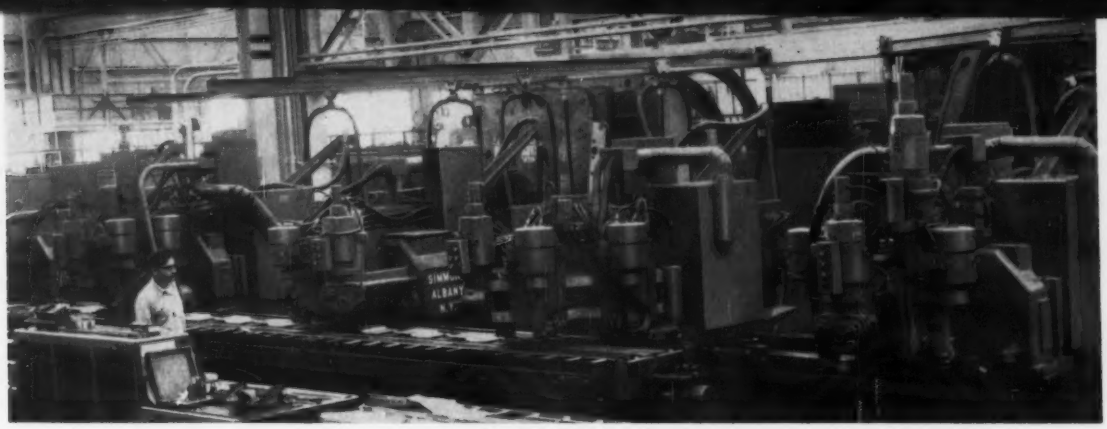


Fig. 3. Six cutting heads on this 90-foot-long machine perform 250 operations to machine generator conductor bars. Included are clamping, wire-brushing, positioning, and welding of copper slugs, milling of ports and tapers, and deribbing. The end of each bar is also cut off and prepared for brazing.

inner casings. The 43-foot-high machine has a work-table 11 feet wide and 13 feet long. During machining operations the work-piece remains stationary.

A numerical positioning system controls both vertical and radial tool positions. There is also a visual indicator using full-sized templates of the tools to trace their position along a template of the work-piece contour. Furthermore, an armored plug-in television camera with a built-in light source is secured to the boring head. This unit transmits a picture showing the cutting action of the tool and the surface condition of the work to a screen on the operating bridge.

Four boring heads, each carrying two gibbed tool-holder slides, cover a working range of 16 to 60 inches in diameter. Electrical components of the numerical positioning system are connected directly to ball-bearing screws to eliminate the possibility of signal error from any gear-train backlash. The television camera views the cutting action of only one tool.

Steam-turbine buckets are being contour-milled on the tape-controlled Ex-Cell-O machine shown in Fig. 2. This is one of four similar machines being installed to handle turbine buckets with over-all lengths up to 72 inches, vane lengths of 60 inches, and maximum widths of 12 inches.

Three-dimensional machining is done in a full circle around the turbine buckets, preparing them for final grinding and polishing. In addition, new designs can be put into production in a matter of days.

Initially, the cutter is set at a predetermined place relative to the center line of the bucket, and the work-table is pre-set relative to the center line of the machine. The cutter moves in and out to conform to the desired shape as the work-piece traverses past it during successively indexed strokes. Roller supports back the work-piece against the thrust of the cutter.

A unique application of automation to a job shop is found in the 90-foot-long Simmons milling machine, Fig. 3, which performs 250 operations on generator conductor bars. It is under the complete control of two card readers. Both a rib

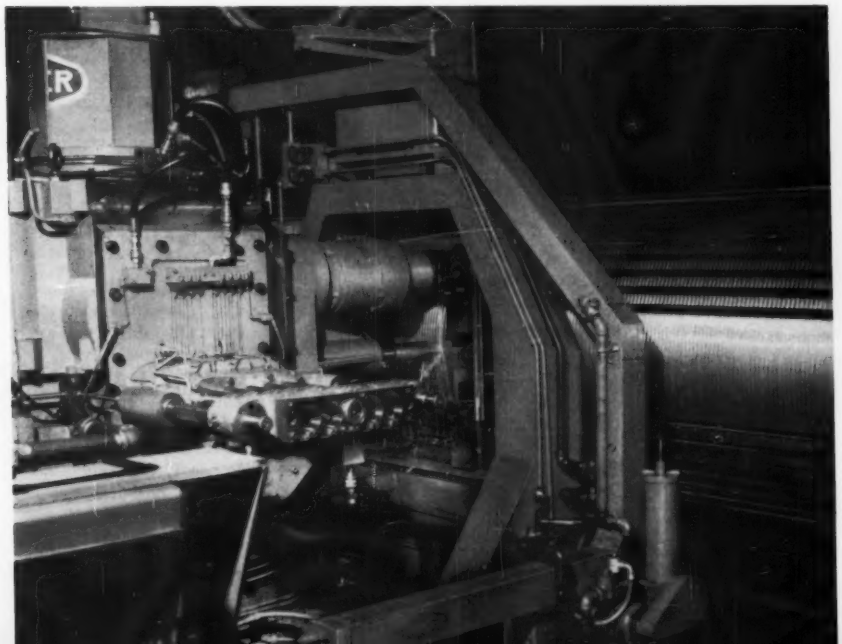


Fig. 4. Drilling, reaming, and milling as many as 2700 holes in rotors measuring 24 feet in length and weighing up to 90 tons is the task of this tape-controlled machine. Holes up to 1 3/4 inches in diameter and 12 inches deep can be drilled singly, as here, or five at a time. A five-spindle head can be mounted on each face of a four-faced turret.

section and a cover section of the hollow, copper conductor bars are placed parallel to each other and are machined at the same time. Each bar averages 19 feet in length, is 1 3/4 inches wide, and about 5/16 inch thick.

Six heads perform the necessary operations on the bars. Head No. 1 actuates holding clamps and wire-brushes the material being worked. At the second head slugs are dropped in place to block passages and are welded. Each bar requires about twenty-six slugs, which are automatically fed from a hopper. Front side-ports and back-end tapers are cut at the third head. Heads No. 4 and 5 make 45-degree cuts on both sides of each bar, while head No. 6 is for deribbing, or channel widening. It also makes the end cutoff and prepares the bars for subsequent brazing.

At the touch of a button, the multiple-spindle, tape-controlled machine illustrated in Fig. 4 starts to drill and ream more than 2000 holes in massive generator rotors. This new Baker machine is capable of handling rotors with a body length up to 24 feet and weighing up to 180,000 pounds, and can be adjusted to accommodate diameters from 30 to 64 inches. A removable head containing five spindles for drilling and reaming is located on each face of a four-faced turret. The spindles can accommodate tools up to 1 3/4 inches in diameter and drill holes to a depth of 12 inches.

Some rotors have as many as 2700 ventilating holes, 3 inches deep. Multiple holes are drilled along a straight line based on uniform spacing, but these uniform spacings may be skipped, as the longitudinal motion is completely controlled by selsyn measurement from punched tape. The tape will indicate when tools should be removed, when groups of holes are to be skipped, or when an individual hole is to be drilled which is not in the normal multiple sequence. It is also possible to remove the drilling heads on one of the turret faces and mount a vertical slide which will accommodate a multiple-spindle head to permit tangential milling of air entrance slots.

69 Engineering Students Win Machine Design Awards

The following 1959 graduates have been named by their respective engineering colleges as the recipients of MACHINERY's Achievement Award for outstanding excellence in machine design. In one instance awards were given to the two leading machine design students in their respective day and evening school graduating classes. Each recipient received a one-year's subscription to MACHINERY, together with a copy of MACHINERY's HANDBOOK and its companion volume "The Use of Handbook Tables and Formulas."

This is the fourth year that MACHINERY has presented these achievement awards. Sixty-eight engineering colleges participated as against sixty-three in 1958. Twenty-nine states were represented in this year's awards.

Alabama Polytechnic Institute	JAMES B. ASKEW	Auburn, Ala.
Carnegie Institute of Technology	WILLIAM T. OSBORNE	Cincinnati, Ohio
Case Institute of Technology	RICHARD POLACEK	Cleveland, Ohio
City College	ALGIS EIDUKEVICIUS	Brooklyn, N. Y.
Colorado School of Mines	JOSEPH R. MCKEE	Golden, Colo.
Colorado State University	EDWARD L. YELLIN	Fort Collins, Colo.
Cooper Union	AARON LOWIN	New York City
Cornell University	ROBERT A. LYLE	Pittsburgh, Pa.
Dartmouth College	STEPHEN W. DUNN	Winchester, Mass.
Drexel Institute of Technology	STANLEY MALANOSKI	Havertown, Pa.
Georgia Institute of Technology	JAMES M. AKRIDGE	Birmingham, Ala.
Illinois Institute of Technology	EDWARD E. MESSAL	Chicago, Ill.
Johns Hopkins University	LEO J. CLARK	Baltimore, Md.
Kansas State University	RALPH COZINE	Greenleaf, Kan.
Lafayette College	RONALD L. ESHLEMAN	Hershey, Pa.
Lehigh University	DAVID MITCHELL	Bethlehem, Pa.
Massachusetts Institute of Technology	THOMAS A. COOK	Pasadena, Calif.
Michigan State University	EDWIN J. BUEHLER	East Lansing, Mich.
Newark College of Engineering	STANLEY E. VERNOVAGE	North Bergen, N. J.
New York University	WILLIAM VON GLAHN	Valley Stream, N. Y.
Northeastern University	JOSEPH D'APRILE	Milford, Mass.
Northwestern University	MURRAY Q. TANNER III	Kirkwood, Mo.
Norwich University	RICHARD D. HAYES	Manchester Center, Vt.
Ohio State University	JOHN C. EBY	Springfield, Ohio
Oklahoma State University	CHARLES E. NUCKOLLS	Ponca City, Okla.
Pennsylvania State University	ROBERT M. MCCASH	University Park, Pa.
Polytechnic Institute of Brooklyn	JERRY M. MENDEL	Flushing, N. Y.

Pratt Institute	JOHN MULLER	Bayside, N. Y.
Princeton University	CHARLES A. MCNARY	Evanston, Ill.
Purdue University	RICHARD E. WATSON	University City, Mo.
Rensselaer Polytechnic Institute	HARRY O. OHMSTEDT	Saratoga Springs, N. Y.
Rice Institute	WILLIAM R. SCHMIDT	Houston, Texas
Rose Polytechnic Institute	PERRY FOLTZ	Terre Haute, Ind.
Stanford University	PAUL E.THIESS	Lake Grove, Ore.
Stevens Institute of Technology	JAMES G. HANSEL	Forest Hills, N. Y.
Swarthmore College	SETH GIBSON	Belmont, Mass.
Syracuse University	LUKE DZWONCZYK	Utica, N. Y.
Tufts University	JOHN A. MEUSE	Everett, Mass.
Union College	HAROLD BISHOP, JR.	Schenectady, N. Y.
University of Alabama	PAUL T. HOWSE, JR.	Birmingham, Ala.
University of Arizona	ROBERT J. BENEDICT	Kearny, Ariz.
University of California	ROBERT P. HERZOG	Oakland, Calif.
University of Colorado	HAROLD B. MOSER	Denver, Colo.
University of Connecticut	ROBERT DIGIOVANNI	Glen Cove, N. Y.
University of Idaho	JOHN HOCH	Boise, Idaho
University of Illinois	JAMES F. DEPAUW	East Moline, Ill.
University of Kansas	RONALD J. WILSON	Kansas City, Mo.
University of Maine	DALE A. YOUNG	Orono, Me.
University of Maryland	JOHN C. KRIMMELL	Towson, Md.
University of Massachusetts	RAYMOND T. FREEMAN	Amherst, Mass.
University of Michigan	RONALD D. BOS	Ypsilanti, Mich.
University of Minnesota	ROBERT A. RUSTIN	Minneapolis, Minn.
University of Nebraska	ERNEST L. MOSER	Lincoln, Neb.
University of Notre Dame	GEORGE P. MCANDREWS	Clinton, Iowa
University of Pennsylvania	RONALD L. HUSTON	Philadelphia, Pa.
University of Pittsburgh	GEORGE F. REUSS	Irwin, Pa.
University of Rhode Island	RICHARD A. LAFLEUR	North Smithfield, R. I.
University of Southern California	VICTOR QUAN	Los Angeles, Calif.
University of Texas	GEORGE A. HELLAND, JR.	San Antonio, Tex.
University of Utah	JERRY R. JOHANSON	Salt Lake City, Utah
University of Wisconsin	GENE E. OLSON	Bristol, Wis.
Villanova University	PAUL R. SMARGIASSI	Phildelphia, Pa.
Virginia Polytechnic Institute	ENOCH M. JONES	Langley Field, Va.
Wayne State University	JAMES E. WILLIAMS	Detroit, Mich.
Wentworth Institute	RISTO C. SALOMAA	Medford, Mass.
	ERNEST M. CARMOLLI	Medford, Mass.
West Virginia University	EDWIN H. THOMAS	South Charleston, W. Va.
Worcester Polytechnic Institute	ROBERT W. BOSMA	Whitinsville, Mass.
Yale University	CHARLES J. BARTLETT	Dedham, Mass.

This soft-jaw segment is intended for mounting on a six-jaw, self-centering chuck. It has been designed at the Charlotte, N. C., Division of the Douglas Aircraft Co., Inc., for use on their heavy-duty lathes. To cover a wide range of work, they are cast in three size ranges, depending on the position of the raised gripping ring. A lug is provided at the apex of each segment to aid in turning the jaws preparatory to use for internal gripping.

Machine Trio Cuts Short-Run Piercing Cost

A MODERN production system that eliminates the high cost factors normally associated with sheet-metal fabrication has been developed by the Wiedemann Machine Co., King of Prussia, Pa. Termed "Templamation," this new concept in fast, accurate, short-run piercing has been described as the nearest possible approach to automation and its advantages without use of automatic controls.

By employing templates, and at the same time greatly reducing the cost of making and inspecting them, short-run piercing costs can be cut from 60 to 90 per cent. Layout, tool setup, special die sets, multiple handling, etc., are eliminated. Also, engineering changes can be made on-the-spot.

Three machines work together in the Templamation system—one produces the templates, one inspects them for accuracy, and one does the actual piercing. Templates are made on a "Coordinator," which locates and drills holes at the rate of 100 per hour in a single continuous operation with no manual layout. A template blank up to 36 by 42 inches in size is secured to the cross-slide and is positioned to X and Y center-line dimensions by means of precision optical scanners and graduated scales. When each location is made, a 1/8-inch-diameter hole is made by a drill moving upward through a close-fitting carbide guide bushing. Since all dimensions are taken from the edges of the sheet, there is no cumulative error and accuracy is maintained within plus or minus 0.002 inch.

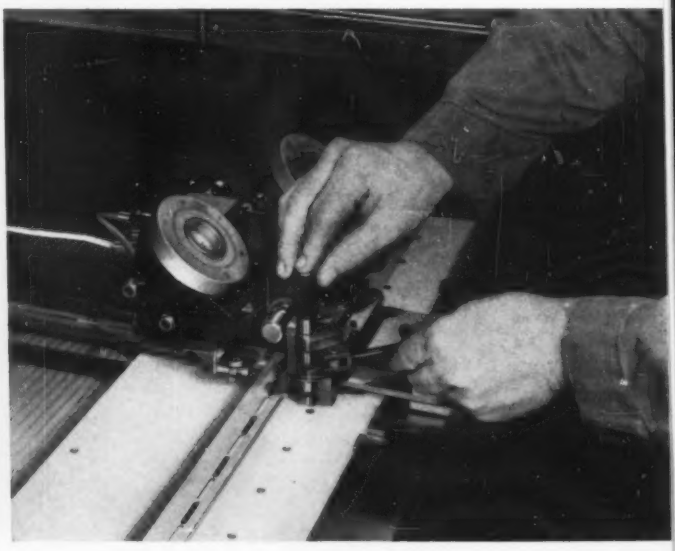
Template accuracy can be checked rapidly on a Wiedemann "Inspector." The work is secured on a flat table top and against two locating edges by quick-acting clamps. A carriage with two optical scanners travels freely over the table—color-coded X and Y scales moving with them. An operator inserts a stylus in each template hole to be inspected. Hole dimensions are then read optically from the graduated scales in 0.0005-inch increments and at one to three holes per minute.

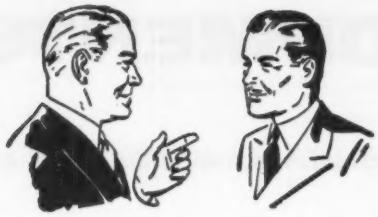
Final link in the chain is the turret punch press. Depending on the particular press being used, from sixteen to twenty different punches and dies are carried in the turret, ready for use. The desired tool can be rotated into piercing position within two seconds.

A blank work-piece is clamped to a pantograph type cross-slide in direct relation to the table-mounted template. As the operator moves a stylus, the cross-slide and work-piece follow. When the stylus point is depressed into a template hole, the work is properly positioned beneath the punch and the press trips. Holes can be located and pierced at the rate of thirty to one hundred per minute. Template holes and turret stations are normally color-coded for rapid identification.

Template holes are being located and drilled to a position tolerance of plus or minus 0.002 inch, and at a rate of about 100 holes per hour, on this "Coordinator," thus eliminating manual layout. Locations are found by optical scanners and graduated scales.

Inserting a stylus into a template hole on an "Inspector." Both the X and Y center-line dimensions for each hole are determined simultaneously within a tolerance of plus or minus 0.001 inch. Holes can be checked at the rate of one to three per minute.





Talking With Sales Managers

By BERNARD LESTER
Management Consulting Engineer

Middle-Managers Need Training, Too

WITH TODAY'S EMPHASIS on volume and profits, the job of the sales supervisor in the field is especially significant. He is a middle-management man who can go a long way toward answering your sales-performance problems. He is located where sales are made or lost, where sales engineers advance or fall back.

In the realm of sales engineering, the term "supervisor" does not quite fit. It implies the instructing of people on how to act, followed by the checking of results. Actually, field sales management at all levels should provide the atmosphere and leadership by which sales engineers prosper and grow. Involved, of course, are sales policies, tools, and quotas but, above all, is included the task of training sales engineers. It is easy to overlook or undervalue this particular function of supervision.

Let us cite an example of one district manager's knack of training young men. His concern—a large, well-known builder of heavy machinery—has paid dividends uninterruptedly for more than fifty years. This manager understood his company's equipment, its application, and sales. And he also understood men. This was true to the extent that an assignment to his territory was highly coveted by most headquarters' sales candidates.

Besides holding periodic group discussions, this manager required that each young man stationed throughout the territory write a personal, longhand letter each week summarizing his experiences and observations. Contents of these letters were revealing. The manager read and acted on each of them with the same sincerity with which they were written.

Now, if we acknowledge the importance of training sales engineers, do we also recognize the necessity for training *managers*? Manufacturing divisions have, for some time, recognized the necessity of middle-management training, but only in recent years have sales divisions taken it seriously. Middle-managers are an expanding group—year by year, all over the country, a constantly higher proportion of wages and salaries go toward supervision. Today more than thirty per cent of these costs fall into this category.

Naturally, managers grow through experience and study of principles—by practice and theory. But only within the last decade or so have the principles of management been closely explored, coded, and applied by an appreciable segment of the sales fraternity. Management, long only an art, is now also a science.

Hence, most top, corporate sales executives have two middle-management training opportunities that should demand attention. The first is that of strengthening experienced managers toward (1) a better grasp of management principles, (2) an understanding of the new functions that constitute the management job, (3) an examination of techniques—such as problem-solving and decision-making, (4) a familiarity with new management tools, for example, the use of computers and electronic processing.

Such help comes from a wide variety of texts, lectures, seminars, etc. One very helpful program is conducted by the American Management Association, which will hold 1100 individual meetings this year in cities, colleges, and at its well-equipped academy at Saranac Lake, N. Y.

The second problem most top sales executives have to meet is how best to provide experience for the incoming business-school graduate trained in management. These young men have collected some very valuable knowledge. This knowledge can be put to good use if seasoned in a position of service, rather than in one of authority. Some mistakes have been made by advancing these fellows too rapidly over experienced middle-managers who lack academic training.

In summary, there are three points that should be highlighted:

1. Consider your middle-management needs, particularly the need for new forms of management training now available.
2. Open up these opportunities to men now in key positions.
3. Take on some textbook-trained managers, but season them with the rigors of discipline.

LATEST DEVELOPMENTS

Machine tools, unit mechanisms, machine parts, and

Farrel-Newton Duplex Cavity Milling Machine with Three-Dimensional Magnetic-Tape Control

Cavity milling operations are performed on opposing sides of work simultaneously under three-dimensional magnetic-tape control by a Farrel-Newton cavity milling machine built by the Farrel-Birmingham Co., Inc., Rochester, N. Y. This machine, Fig. 1, is the first of its type designed to mill ferrous as well as non-ferrous metals. It has the necessary weight and rigidity to mill high-alloy steels at slow feeds and speeds. Each spindle is driven by a 60-hp, adjustable-speed, direct-current motor which, in conjunction with four mechanical speed changes, gives a cutting speed range of 15 to 3600 rpm. This makes it possible to use the most efficient or economical speed for milling iron, steel, or any non-ferrous metal. Fig. 2 shows examples of aluminum forgings milled on the machine. The opposing sides of these forgings were milled simultaneously under three-dimensional tape control. The tape transport of one control is shown in Fig. 3.

Essentially, the machine consists of a work-table and two opposed traveling-column milling units. Each column carries a head saddle, which travels on a vertical slide. Both head saddles carry horizontal milling heads having "in-out" or depth travel on a horizontal slide. The two milling units are used independently under either manual or three-dimensional magnetic-tape control.

Separate floor-mounted control panels, containing magnetic-tape transports, reading heads, and associated controls, are provided for each side of the machine. Telescoping guards are furnished for the bedways, and accordion covers are provided for the vertical ways and the depth-adjusting drive-screw. A reel system is included to carry electrical power and control to each traveling-column assembly without sliding contacts and at a level below the table top.

This equipment can be supplied in a size and with a variety of specifications to meet individual requirements. Because each side of the machine is separately tape-controlled, either side can be furnished alone as an open-side machine. If a duplex machine is required at a later date, the base column and milling head for the second side can be added.

The duplex machine offers a number of advantages. In addition

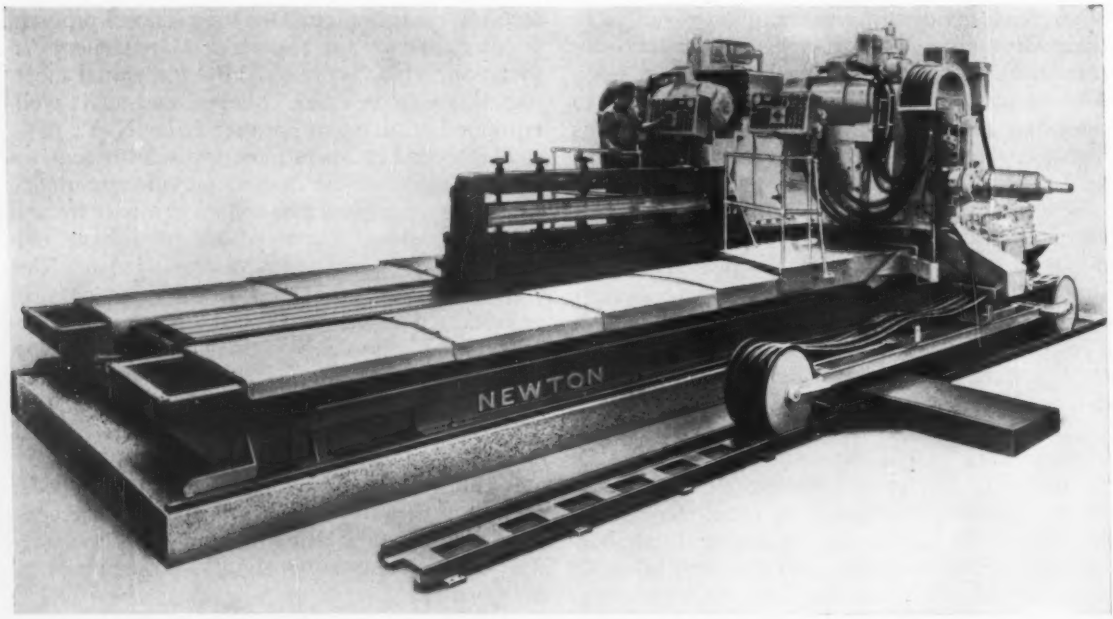
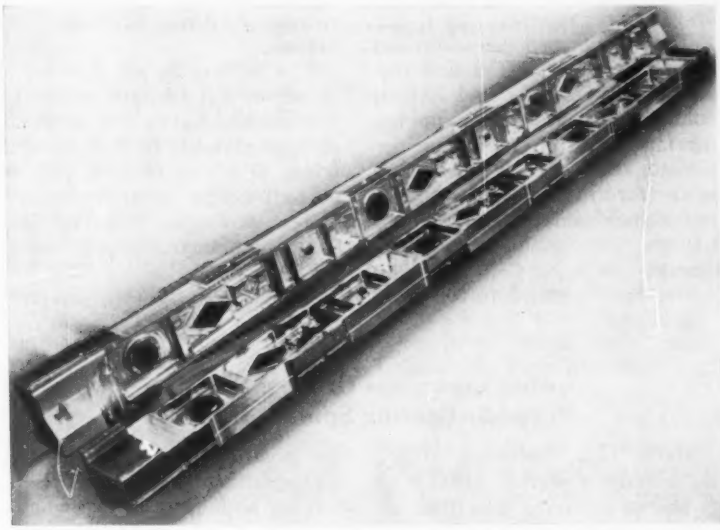


Fig. 1. Farrel-Newton duplex cavity milling machine announced by the Farrel-Birmingham Co., Inc.

IN SHOP EQUIPMENT

material-handling appliances recently introduced

Edited by FREEMAN C. DUSTON



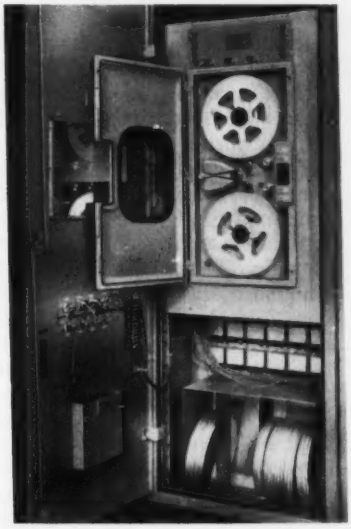


Fig. 2. (Left) Examples of work milled on the cavity milling machine illustrated in Fig. 1
Fig. 3. (Right) Tape transport of one of the control units of cavity milling machine

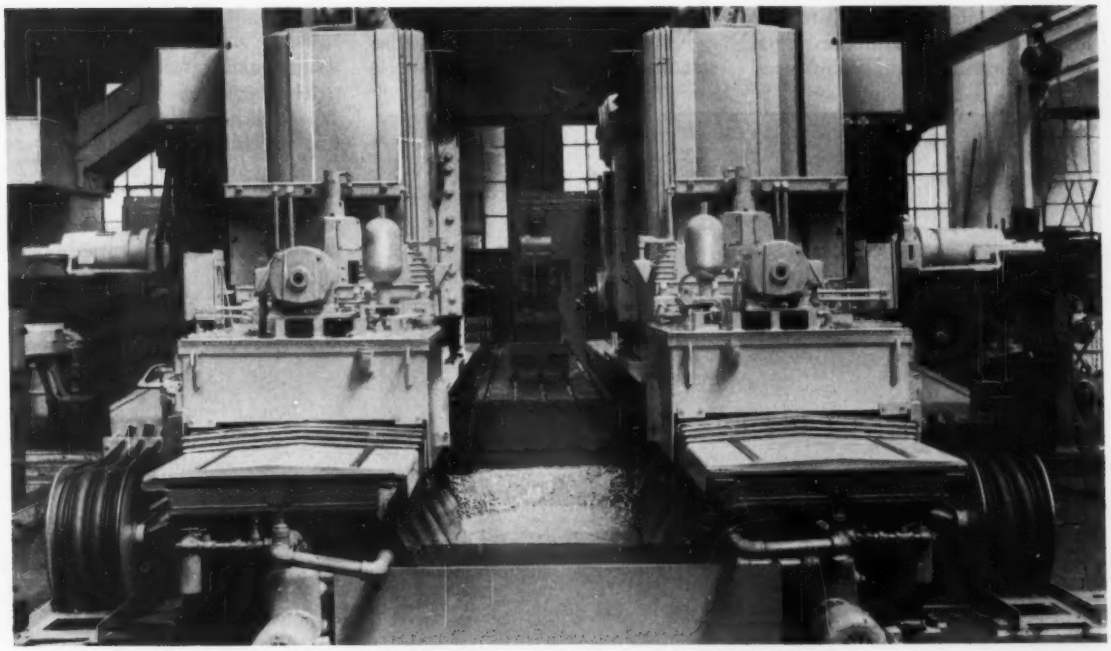


Fig. 4. Rear view of Farrel-Newton duplex cavity milling machine showing the wash system for removing chips between the table and the milling unit

to important reductions in time required for setup and handling the work-piece, actual milling time is halved. It has also been found that there is much less distortion of the forging when both sides are milled simultaneously. Since feed is applied to the column and milling-head units while the work remains stationary, either duplex or open-side machines can be furnished for any desired feed length. Also, a machine already installed can be easily and economically extended to meet increased work-length requirements.

The intricate pattern of squares, diamonds, and circles on the aluminum forgings seen in Fig. 2 was automatically cut on opposite sides of each of the forgings, simultaneously, under three-dimensional magnetic-tape control. Accuracy of the work was held to within tolerances of plus or minus 0.0005 to 0.002 inch, depending on the travel rate.

All feed drives are by electric motors and high-precision reduction gearing. Short, stiff shafting and pre-loaded bearings minimize backlash and total lost motion so that accurate performance of the closed servo-loop system is assured.

Sensitivity is such that the machine will move 0.001 inch for the first 0.001-inch input-motion signal from the differential synchro used in setup orientation. The velocity error constant for all motions in closed servo-loop control is 4 inches per minute for each 0.001 inch. All motions will respond, without loss of synchronization, to a step input of 30 inches per minute, thus, insuring exponential acceleration and deceleration in one command between 0 inch and 75 inches per minute.

The following specifications and dimensions are for the first machine built: column travel, 20 feet; column feed rate (maximum use for tape control), 75 inches per minute; column feed rate (maximum for manual control), 90 inches per minute; and column traverse rate, 298 inches per minute.

The head vertical travel is 24 inches; head vertical feed rate (maximum use for tape control), 75 inches per minute; and head vertical feed rate (maximum for manual control), 90 inches per minute. Head depth travel is 24 inches; the depth feed rate (maximum use for tape control), 75 inches per minute; and the head depth feed rate (maximum for manual control), 90 inches per minute.

The work-table has a width of 30 inches and a length of 24 feet. The machine has an over-all length of approximately 39 feet, over-all width of about 20 feet, and an over-all height of approximately 10 feet. It weighs, including electrical equipment, approximately 160,000 pounds.

Circle Item 565 on postcard, page 199

Norton Centerless Grinder Features Straddle-Bearing Spindle Design

Norton Co., Worcester, Mass., has added a centerless grinder to its line of products. Identified as a No. 2 machine, the equipment can accommodate work up to 4 inches in diameter, with a maximum width for both the grinding wheel and the regulating wheel of 8 inches.

An outstanding feature is the straddle-bearing design of both the grinding-wheel spindle and the regulating-wheel spindle. Support on both sides of the wheels eliminates sag caused by the weight of wheels, as well as any side deflection caused by the pressure of the work, it is claimed. In each instance, the outboard bearing is fixed in a support bracket integral with a heavy wheel-guard cover.

Centerless grinder added to Norton Co. line

The machine has a grinding-wheel slide with a rotating screw for precise feed when plunge-grinding or for fine adjustment (to 0.00005 inch) on through-feed grinding. Since the grinding wheel is fed to the work, the feed line of both the machine and its work-conveying equipment remains fixed. As the wheel wears, the wheel-slide is moved closer to the work-rest, which remains set at one point. Thus, there is no line-up problem where two or more machines operate in tandem.

To true the grinding wheel, the operator feeds a diamond manually, then turns a lever which actuates a hydraulic stroke. A 90-degree step in a wheel can be trued without special equipment.

Regulating-wheel position is readily adjusted by a graduated handwheel. Grinding speed of the

regulating wheel is variable within a range of 8 to 66 rpm. A knob control quickly raises the speed of the regulating wheel for truing. To tilt the wheel, there is an adjusting bolt at the rear of the head.

For high-production plunge-grinding, an automatic feed arrangement provides up to 0.135 inch of rapid approach and feed by a hydraulically powered screw. The motor for the grinding wheel is rated at 15 hp, 1800 rpm; and for the regulating wheel, motor is rated at 1 1/2 hp, 1200 rpm.

Circle Item 566 on postcard, page 199

Warner & Swasey Universal Turret Lathe

A No. 3 universal turret lathe, featuring an eight-speed all-hydraulic clutch type headstock and a single-lever speed pre-selection and change control, is announced by the Warner & Swasey Co., Cleveland, Ohio. Designed to handle bar work up to 1 1/2 inches in diameter, this lathe, Fig. 1, has been specifically developed for high-production operation and easy handling. The single-lever control, Fig. 2, provides both spindle-speed pre-selection and instantaneous speed changing in a one-hand operation. Its direct-reading pre-selector dial tells the operator the exact surface speed for each diameter and spindle speed.

Ample power for heavy metal removal with the latest cutting-tool materials is supplied by a 10-hp reversible-drive motor. The standard single-speed motor provides eight spindle speeds from 90 to 2262 rpm, while an optional two-speed motor supplies sixteen spindle speeds from 45 to 2262 rpm.

The all-hydraulic headstock features a quiet, constant mesh, helical gear train incorporating six separate hydraulic clutches for speed changing and braking the spindle. Headstock controls include a "Forward and Reverse" lever for changing the direction of motor rotation, plus "High," "Low," and "Stop" motor push-buttons. The headstock offers a 25 to 1 ratio over-all speed range.

The control lever, Fig. 2, is mounted on top of the headstock within easy reach of the operator in his normal working position. This single lever is used to select directly and instantaneously any of eight spindle speeds, as well as control "Neutral" and "Brake" functions. Speed pre-selection is accomplished by moving the lever horizontally to the left or right; actual speed changing is done by raising or lowering the lever to the appropriate speed position. Speeds may be pre-selected while the spindle is running.

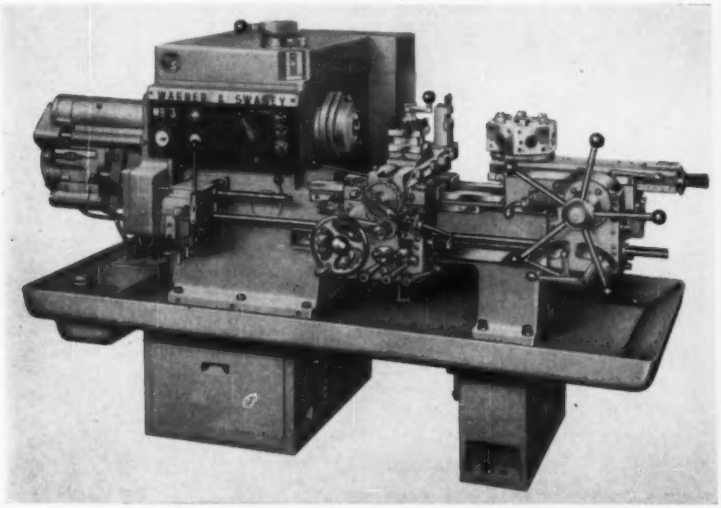
As a safety measure, a special latch arrangement, released by a thumb lever on the control handle, is provided in both "Neutral" and "Brake" positions to prevent accidental spindle engagements while chucking or gaging a work-piece. A touch of the conveniently located control lever opens the collet and feeds the bar any length up to 7 inches. Pushing the lever closes the collet and strips the bar-feed head for another stroke.

Six reversible cross and longitudinal power feeds are provided for the universal cross-slide. Cross-feeds range from 0.0025 to 0.026 inch and longitudinal feeds from 0.003 to 0.030 inch. The cross-slide carriage is rigidly mounted across the ways and the apron is further supported by a third rail at the base of the bed. Bedways are induction hardened and ground.

The ram slide, with automatic indexing and locking hexagon turret, is provided with six power feeds, from 0.003 to 0.030 inch. Adjustable stops are supplied for each turret face.

Adjustable taper gibs at each side and under the top caps of the turret slide, plus hardened-steel wear strips under the slide, assure continued fit and accuracy under all shop conditions.

Circle Item 567 on postcard, page 199



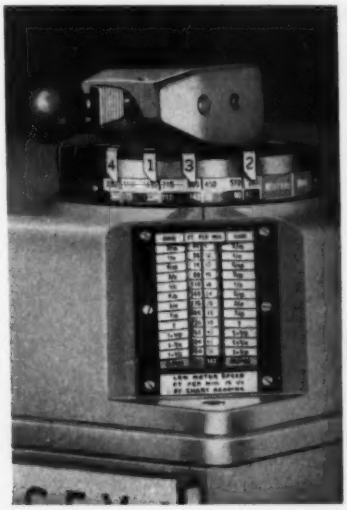


Fig. 1. (Left) Universal turret lathe with eight-speed all-hydraulic clutch type headstock. Fig. 2. (Right) Close-up of single-lever control.

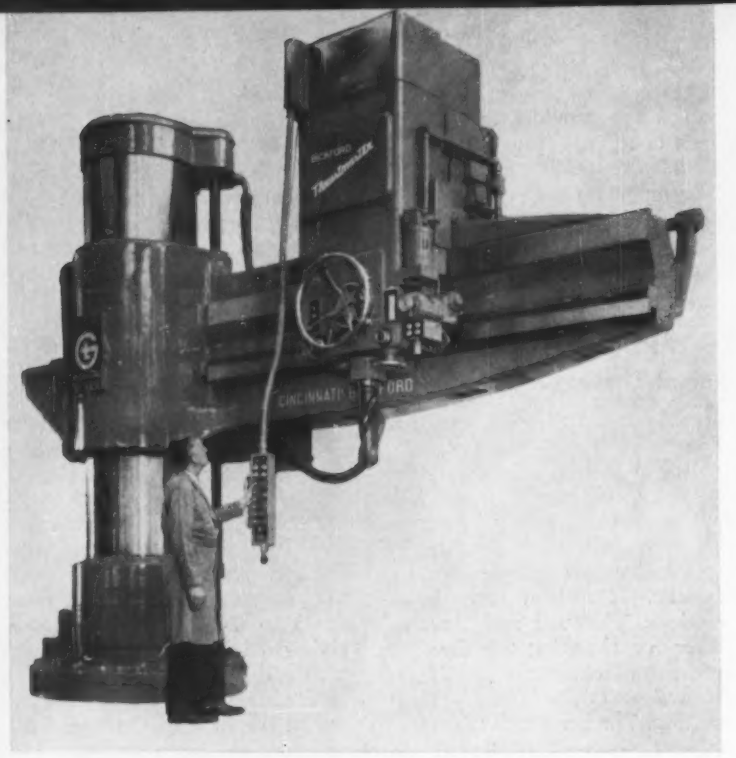
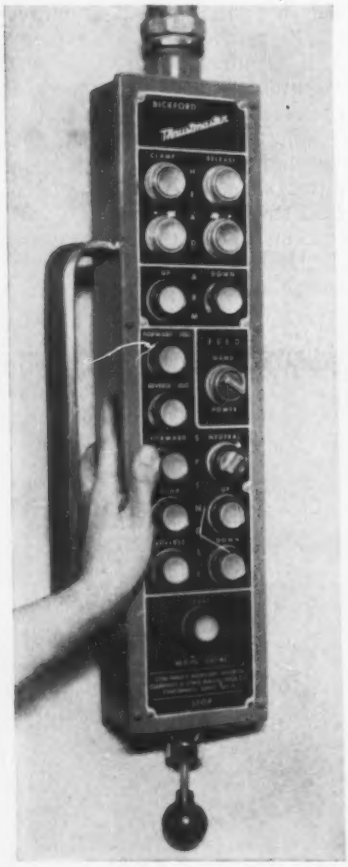


Fig. 1. Cincinnati Bickford "Thrustmaster" radial drilling machine

Giant-Size "Thrustmaster" Radial Drilling Machine

A 40-ton "Thrustmaster" radial drilling machine with a column 34 inches in diameter has been announced by the Cincinnati Bickford Division, Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.

Two of these giant-size machines, said to be the most powerful in the world, have been completed and are being shipped to the Large Steam Turbine-Generator department of the General Electric Co., Schenectady, N. Y. The machine, shown in Figs. 1 and 3, has a 10-foot arm, 50-hp driving motor, full pendent control, rapid traverse to spindle, power-assist for swinging the arm, and complete pre-selection of thirty-two speeds and eighteen feeds. The standard "Thrustmaster" with 34-inch diameter column



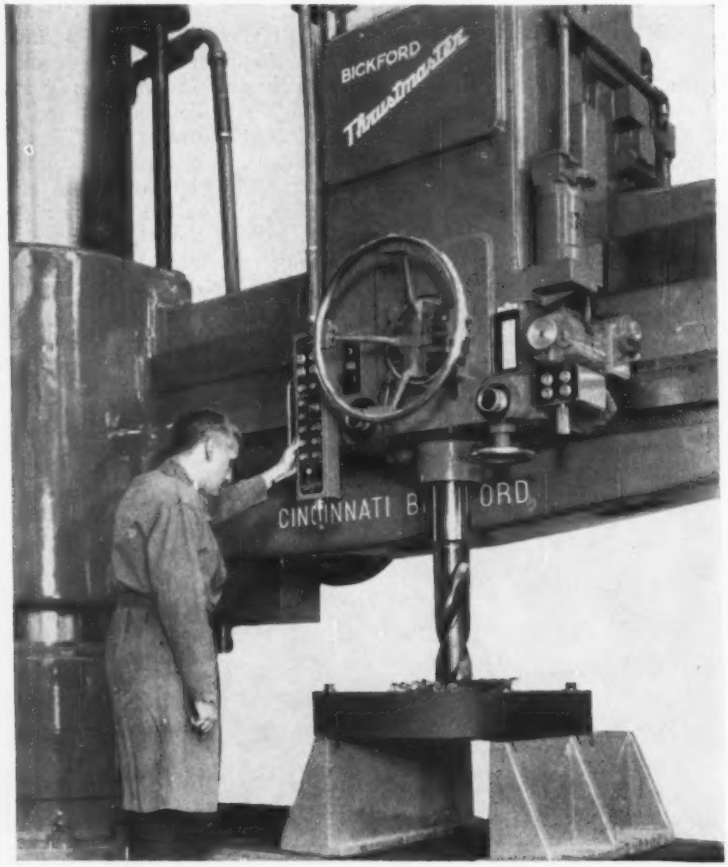


Fig. 2. (Left) Close-up of full pendent control of machine shown in Fig. 1. Fig. 3. (Right) Drilling a 5-inch diameter hole in solid steel with Morse high-speed steel twist drill on machine shown in Fig. 1

is available with a 10-, 12-, or 14-foot arm. Each of the two machines built for the General Electric Co. has a 10-foot arm, 9-foot clearance under the spindle, and weighs 81,000 pounds. These machines will be used for drilling and back-facing operations on turbine housings.

Full pendent control enables the operator to easily manage the machine, regardless of the position of the arm. Push-buttons in the pendent, seen in close-up in Fig. 2, operate the power rapid traverse to the spindle and to the head, power engagement of the driving clutch, hydraulic head and column clamps, the arm movement, and up or down travel. A safety master-stop switch extends from the bottom of the pendent station. An all-new feature is a power-assist to aid the operator in swinging the huge arm. Operation of the power-assist is controlled from a knurled knob located on the right side of the head.

Seven angular-contact anti-friction bearings, pre-loaded to give maximum rigidity, support the spindle. Four bearings take direct vertical thrust while the other three carry back-facing loads. The spindle is 3 1/2 inches in diameter and the chromium-plated spindle sleeve, 6 3/4 inches in diameter. Spindle travel is 28 inches. Power for heavy drilling loads at slow speeds is transmitted smoothly to the spindle through a large herringbone driving gear. When high spindle speeds are desired, the herringbone gear is de-clutched and the drive is then through a smaller spur gear, thus eliminating the usual flywheel effect.

Versatility for a wide range of work is provided by thirty-two speeds in one of two ranges of 6 to 875 and 9 to 1300 rpm (145 to 1 ratio), eighteen feeds in a range from 0.004 to 0.125 inch, and tap leads of 8, 10, 11 1/2, 14, 20, and 27 threads per inch. Complete preselection of both speeds and feeds is available while the spindle is running. Feeds are selected by a manually positioned rotary valve. Speeds are selected by an electrical switch which controls a series of solenoid valves.

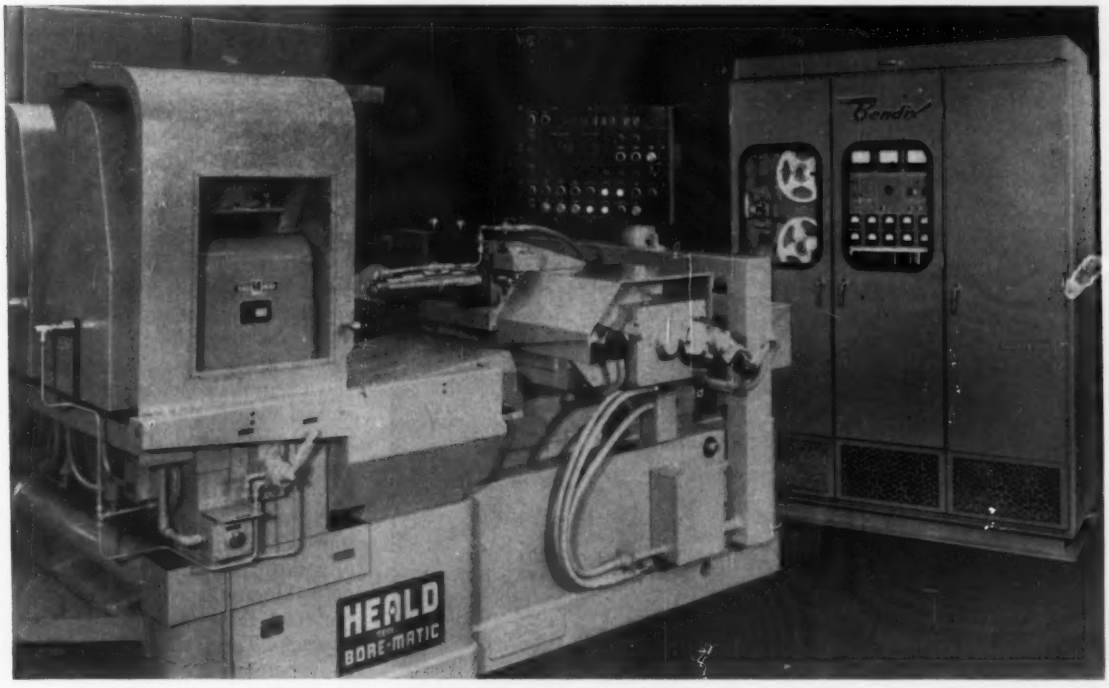
The 34-inch diameter column sleeve is a high grade, gray-iron casting. The inner column is a solid steel forging. The column and sleeve assembly are supported by pre-loaded bearings at both the top and the bottom. The forged inner column, coupled with the pre-loaded column bearings, provides great rigidity against deflection under heavy drilling loads.

Circle Item 568 on postcard, page 199

Numerically Controlled Precision Turning and Boring Machine Equipped to Process Hemispherical Parts

A numerically controlled, double-spindle turning and boring machine that will precision-machine inside and outside contours of hemispheres, cylinders, and other related parts has been announced by the Bendix Industrial Controls Section, Bendix Aviation Corporation, Detroit, Mich. The two-axis, numerically controlled tool system of the machine was designed and built cooperatively by this company and the Heald Machine Co., Worcester, Mass.

Adapting numerical control to the single-point, two-axis turning



Heald Bore-Matic precision turning and boring machine equipped with a Bendix numerical-control system for producing hemispheres, cylinders, free form turned shapes, and other related type hollow metal parts

and boring machine makes it possible to repeatedly machine work of the kind described to a tolerance of plus or minus 0.0001 inch. In many instances, tolerances of plus or minus 0.000070 inch are maintained on critical inside and outside diameters. The Bendix numerical-control system provides a command pulse value to each of the two machine slides of 0.000025 inch or 40,000 pulses per inch of slide travel.

In operation, one spindle machines the outside diameter and the other, the inside diameter of the part. Only one spindle is operated at a time. The work-piece is clamped in a rotating fixture attached to the spindle. A single-point tool, which is mounted on two hydraulically operated slides, is numerically controlled in two axes (logitudinal and transverse) to machine the part to the desired shape within extremely close tolerances. This numerical-control system provides an extremely versatile method of machining any number of different part shapes with only one machine tool. In addition to the advantages of versatility, the system is said to reduce tooling costs, increase production, and shorten the over-all manufacturing cycle as compared to conventional methods.

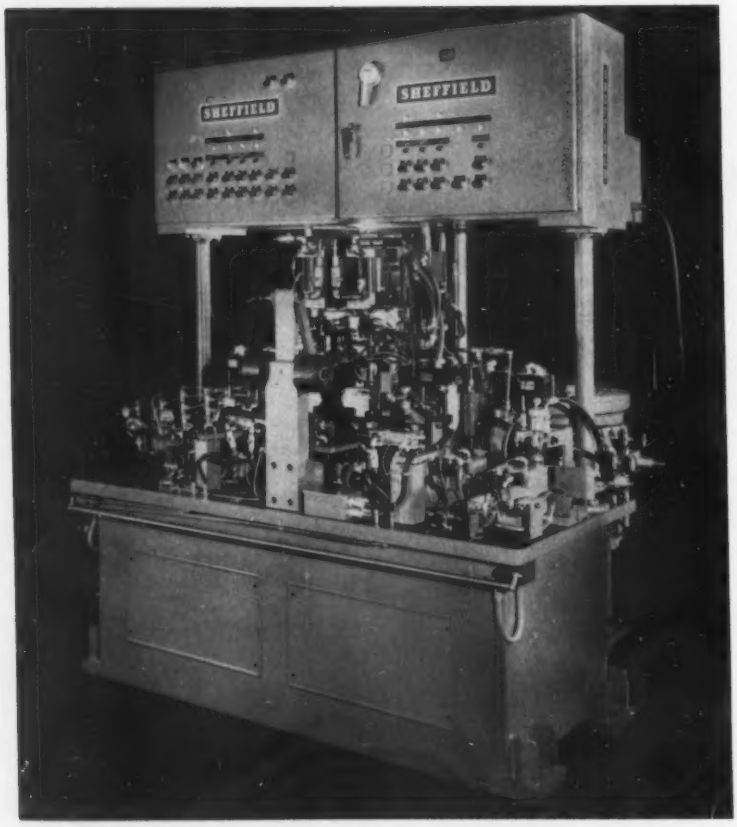
The numerically controlled Heald Bore-Matic machine tool illustrated has a 14-inch maximum swing and can accommodate parts up to 18 inches long. The two spindle heads are driven by a variable-speed, alternating-current motor drive which provides a constant surface cutting speed over a 5 to 1 ratio. Spindle speed can be varied from 50 to 1500 rpm by changing sheaves and drive arrangements. Table travel is 20 inches and cross-slide travel, 15 inches. The top of the table slide and the base of the cross-slide are integral. Precision gib adjustment allows accurate tracking over full slide travel within 0.000025 inch.

The base weldment is normalized to provide extreme, permanent accuracy. The slide ways are hardened and ground box type steel bars. A bridge mounted on the base holds two super-precision heads having a spindle runout of only 0.000020 inch. They are oil-mist lubricated to maintain constant temperature in operation.

Circle Item 569 on postcard, page 199

Sheffield Automatic Assembling Machine

The five components of an automobile distributor vacuum contact arm are automatically assembled at the rate of 900 or more units per hour on a machine manufactured by the Sheffield Corporation, Dayton, Ohio, a subsidiary of Bendix Aviation Corporation. The parts assembled are the arm, washer, diaphragm consisting of two parts, and the retainer ring. Automatic assembly of these five parts is said to have increased production and resulted in better quality at lower cost. In addition, less space is required for the assembling work. The machine is 4 by 7 by 8 feet high.



Automatic machine for assembling five small parts brought out by the Sheffield Corporation

Briefly, the assembly operation is as follows: The arm is placed on a receiver that transfers it to the first assembly station. Here, a hopper-fed washer is automatically placed on the arm. The assembly is then transferred to the next station and the diaphragms, automatically blanked and pierced from two separate rolls of rubberized fabric, are added. Following this, the assembly is indexed to the next station, where the retainer ring is added and staked. The final operation is to coat the staked spot with sealing compound.

A maintenance and timing system is built into the machine that allows quick connection of a Sheffield "Monitorecord" sequence time recorder through a standard receptacle. The machine is designed to accommodate three different sizes of arms.

Circle Item 570 on postcard, page 199

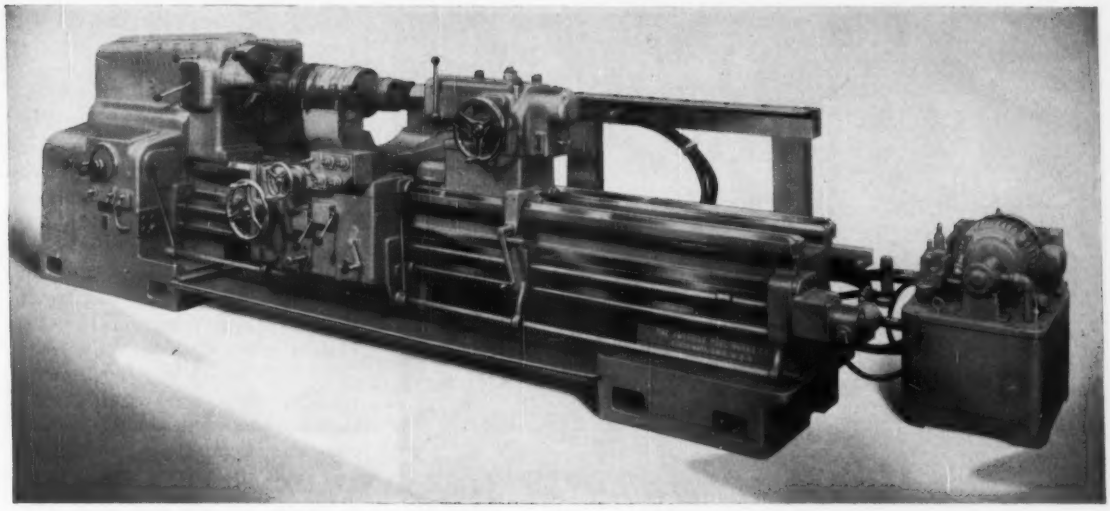


Fig. 1. Hydraulic roll-duplicating lathe brought out by the American Tool Works Co.

Hydraulic Roll-Duplicating Lathe

A hydraulic roll-duplicating lathe, designed for accurate contour-machining of mill rolls up to 33 inches in diameter, is being introduced by the American Tool Works Co., Cincinnati, Ohio. This machine is equipped with a new template-controlled, hydraulic duplicating mechanism and 90-degree tool-slide which handles all roll-tracing work. Carriage feed is continuous, with the rate of feed automatically and steplessly varied (modulated) as the steepness of the contour varies. The feed rate ranges from zero on a 90-degree shoulder to the maximum pre-set by the operator for a straight diameter. The result is a stepless generation of the contours on the roll. Final finishing or touching-up operations are no longer necessary.

The roll-duplicating lathe provides a continuous, uninterrupted cut from one end of the roll body to the other, generating automatically any desired roll contour without constant vigilance by the operator. It also may be used for turning roll necks by tracer control. By switching a conveniently located lever at the head end, the lathe can be instantly changed from a roll-contouring or tracing lathe to a standard engine lathe.

The tool-rest is especially designed to permit mounting a full-length tool support under the extended tools which must be used when the grooves in the roll are deep. The tools which generate the contours have round-nosed carbide tips, either brazed or clamped on the shanks.

The new equipment is basically the latest American Deluxe Model Pacemaker lathe with the hydraulic duplicating equipment built in to form a packaged unit. This insures a powerful, rigid, conveniently controlled, and easily operated unit for the functioning of the hydraulic duplicating equipment in copying various roll shapes from a template.

A massive tailstock with oversized spindle features a built-in, ball-bearing, revolving center of ample capacity to support the largest and heaviest roll for which each size lathe is recommended. These lathes are available in several sizes.

Circle Item 571 on postcard, page 199

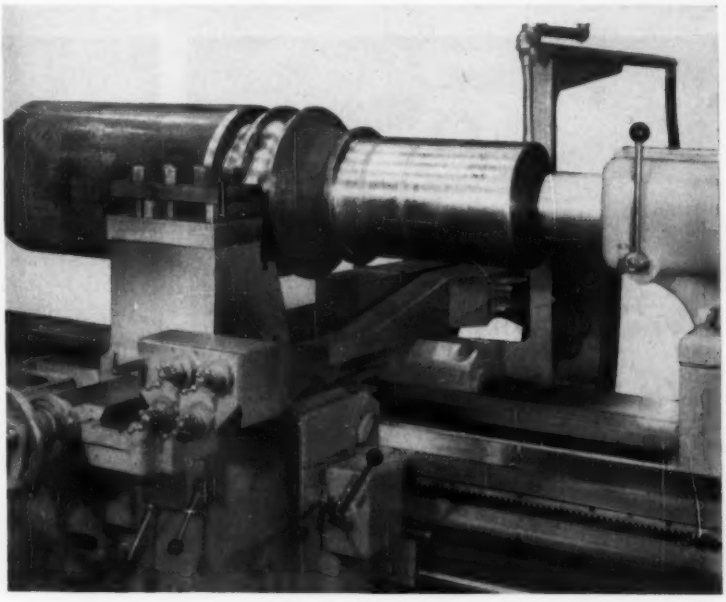


Fig. 2. Tracer-controlled tool-slide of machine shown in Fig. 1

Fig. 1. Thirty-station Transfer-matic designed and built by the Cross Company for a European automobile manufacturer

Transfer-matic for Processing Crankshaft Bearing-Cap Clusters for European Automobile Engine

Techniques for handling and machining crankshaft bearing-cap clusters that represent a complete departure from conventional methods have been developed and applied in the design of a thirty-station Transfer-matic built by the Cross Company, Detroit, Mich., for a European automobile manufacturer. Changes in methods and outstanding features include improved bolt hole processing, lift-and-carry part transfer, a new sawing head and fixture, and new material-handling and fixturing. The output of this machine, shown in Fig. 1, is 436 caps (109 clusters) per hour at 100 per cent efficiency. Operations performed include milling, drilling, reaming, forming, and sawing.

The bolt holes in the bearing caps, Fig. 2, are drilled and reamed from the top-face side in this Transfer-matic. Thus, wandering of any drills that may be ground slightly off center does not affect hole center distances where the locating pins enter the parts when they are clamped in the sawing station. In addition to machining bolt holes, anchor-lock notches, felt seal and oil slinger grooves, the machine drills a hole pattern on the No. 1 bearing cap and saws the cluster into individual caps.

In Fig. 3 is shown the unusual vertical, way type, combination eight-spindle cutter-head which chamfers bearing-cap bolt holes and mills the anchor-lock notches in the bearing caps. The drill spindles and cutter arbor are powered by a single 5-hp motor which operates at a speed of 1000 rpm.

The turnover-transfer mechanism, Fig. 4, lifts the bearing-cap cluster out of Station 19, turns the part over, and lowers it into Station 20. A similar mechanism is employed for indexing the part 140 degrees and placing it on the shuttle-transfer bar mechanism that carries it into the clamping fixture in the sawing station at the end of the machine.

A sawing unit, Fig. 5, facing the left-hand side of the machine, saws the bearing-cap clusters into individual caps. The fixture holds the

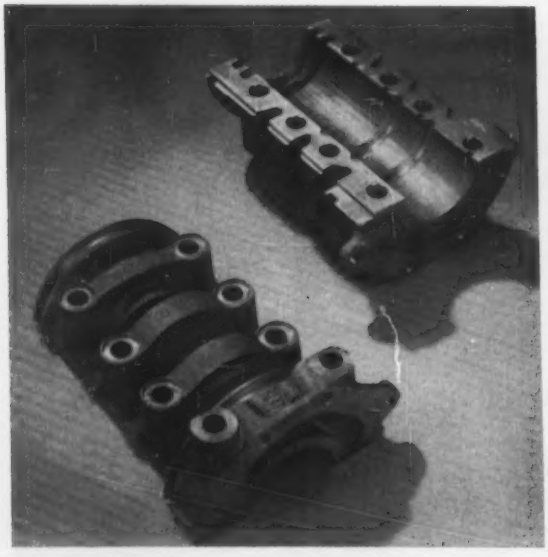


Fig. 2. Crankshaft bearing-cap clusters processed on Transfer-matic shown in Fig. 1

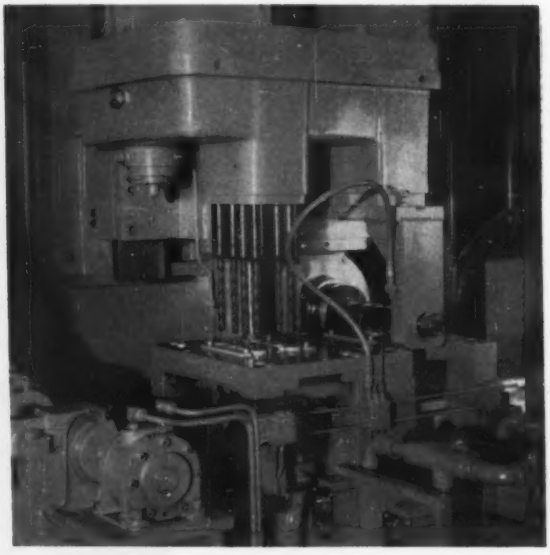


Fig. 3. Vertical, way type combination eight-spindle chamfering and gang-milling cutter-head

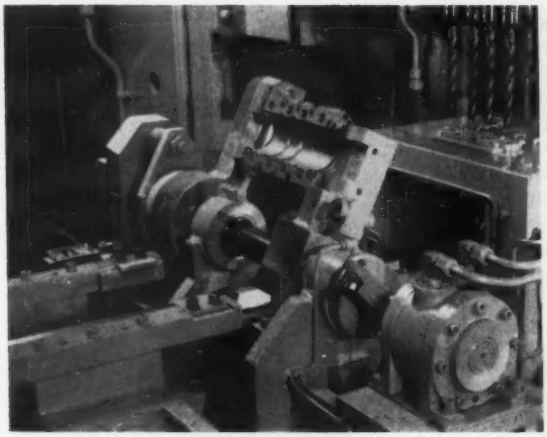


Fig. 4. Turnover-transfer mechanism of machine shown in Fig. 1 which lifts work out of one station, turns it over, and lowers it into succeeding station

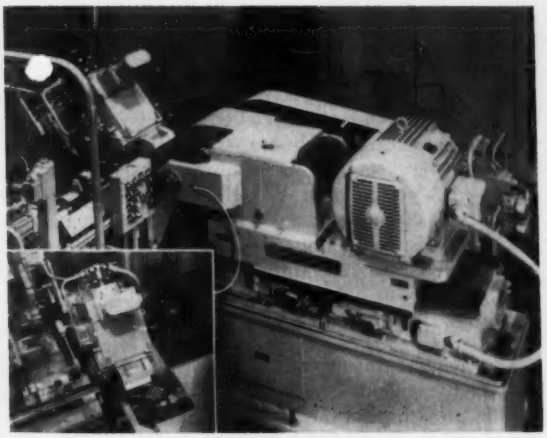


Fig. 5. Sawing unit of Transfer-matic machine which saws bearing-cap clusters such as shown in Fig. 2 into individual caps and unloads work

part up on a 40-degree angle and minimizes milling head overhang. Ample room is provided beneath the fixture for chip disposal. In operation, the part is clamped, lifted out of the last work-station of the machine (left), transferred forward, and placed on the shuttle bar which carries it into the fixture. The preceding cluster is simultaneously unloaded.

Circle Item 572 on postcard, page 199

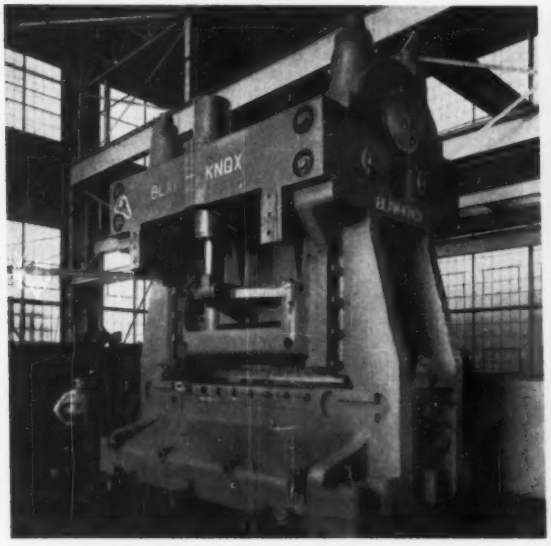
Blaw-Knox Bloom, Slab, and Plate Shear

A combination bloom, slab, and plate shear capable of exerting a knife pressure of three million pounds has been built by Blaw-Knox Co., Pittsburgh, Pa., for the Algoma Steel Corporation, Ltd., Sault Ste. Marie, Ontario, Canada. This down-cut, start-and-stop type, motor-operated shear will cut blooms up to 14 by 14 inches, slabs 60 inches by 8 inches, and plate up to a width of 108 inches. The shear unit illustrated, when installed, will include a shear-depressing and pull-back table, a motor-operated shear gage, crop pusher, chute, and hoist.

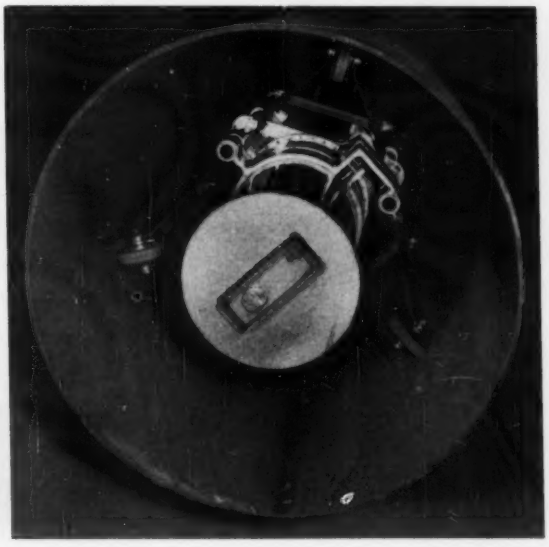
Circle Item 573 on postcard, page 199

"Travel-Ray" Designed to X-Ray Pipe Weld

A machine which can radiograph every inch of weld in a 40-foot length of pipe in less than one minute has been announced by the Travel-Ray Corporation, Houston, Tex. This equipment, trade-named "Travel-Ray," incorporates an X-ray tube of patented design which projects a narrow beam of parallel rays



Combination bloom, slab, and plate shear



Inspecting pipe weld with "Travel-Ray" X-ray unit

only, permitting radiography of the longitudinal welds in pipe sections while the X-ray source is in motion.

Pipe can be "Travel-Rayed" at the mill, in the field, and elsewhere, vastly accelerating pipeline operations at every stage. This equipment can also be used to radiograph only circumferential welds.

The unit is easily adjustable for pipe diameters from 12 through 36 inches, features special six- and twelve-wheel drive crawlers, and offers variable band width, speed, and power up to 250 kilovolts. A quick-disconnect cable eliminates the need for reversing the motor at the end of the pipe section, and a patented rail system is available for pipe-mill and other high-production applications.

Circle Item 574 on postcard, page 199

Extra-Long Steelweld Press Brake

The longest machine built to date in the line of Steelweld hydraulic press brakes has just been completed by the Cleveland Crane & Engineering Co., Wickliffe, Ohio. The machine, a Model LH14-14, will accommodate mild-steel plate up to 20 feet wide by 5/16 inch thick. The ram is driven by two hydraulic cylinders and is kept level by electronic control. If desired, it can be tapered. Also, it may be reversed at any point in the stroke.

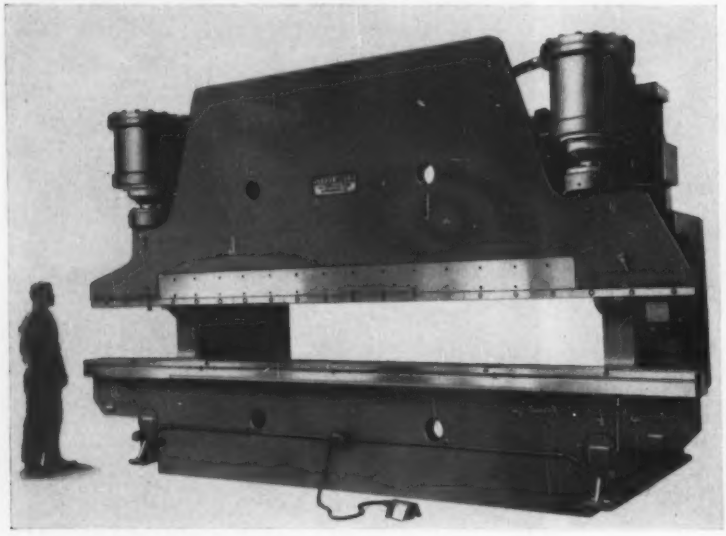
The entire power package consisting of the oil reservoir, pump, motor, valves, and gages is mounted at the top of the machine and fitted to the end housings. If desired, the power package can be removed from the press and handled as a unit.

The unit is very flexible in operation. Its ram travel, for example, can be adjusted quickly to suit an operation without waiting for the machine to travel through any standard cycle pattern. This feature can greatly reduce time required for repetitive operations and speed up production. To further step up production, the ram can be made to approach the work and return from it at high speed, but go through the pressing portion of the stroke at a slow speed as dictated by the metal being formed.

The machine cannot be damaged by overloading. This is true regardless of the size plate put into the press. Because of the hydraulic design, the ram will simply stop without harm to the machine. It can be backed away immediately.

The equipment illustrated is rated at 500 tons. Other Steelweld hydraulic press brakes are available in capacities from 200 to 2000 tons, and for plate widths up to 30 feet.

Circle Item 575 on postcard, page 199



Steelweld press brake designed to handle wide sheets

Optical comparator equipped with mercury-arc lamp unit

Light Source for Optical Comparators

The Jones & Lamson Machine Co., Springfield, Vt., is introducing a new mercury-arc lamp light-source unit for use with all of its 14- and 30-inch screen optical comparators. This mercury-arc lamp is said to provide more than five times the intensity of the best filament light sources previously available. The high-intensity magnification produces an extremely bright, sharp shadow image even at the highest levels of magnification. It is claimed that the greatly improved definition of the image results in greater precision of optical inspection and measurement.

The new lamp comes as a packaged unit, the control element measuring 3 by 2 1/2 by 1 1/2 feet. The unit, described as a universal device that accommodates various standard makes of mercury-arc lamps, is safeguarded by a system of interlocking limit switches, and is self-cooling. Change-over from a conventional lamphouse is quickly and easily accomplished. The quality of the light produced is described as an intensely bright, steady arc, with no flickering. The light can be filtered for use at low magnifications. The illustration gives some idea of the sharpness of the shadow image of a fifty-seven-tooth gear with a base-circle diameter of 1.1159 inches when magnified 270 times.

Circle Item 576 on postcard, page 199

Improved Turret Drilling, Boring, and Tapping Machines

Burgmaster turret drills are referred to as "the machines that use their heads" because they permit a predetermined sequence of machining operations to be effectively carried out in their proper order with minimum work shifting. These turret drills are built by the Burg Tool Mfg. Co., Inc., Gardena, Calif. Improvements in the 1 C model, which has a 3/8-inch diameter drilling capacity in steel, include heavier, simpler transmission and clutch assembly for driving the six spindles. The turret head is counter-weighted by an easily adjustable coil spring to provide a sensitive counterbalance for the turret and slide regardless of the weight of tooling. The spring can be set so that it returns the slide to the top of the stroke or so that it just counterbalances the weight of the slide and head. This reduces operator fatigue and results in more work per shift. New gibs are provided that maintain greater accuracy for long periods of time.

The machines feature power indexing turrets which permit a sequence of operations to be performed for a given hole at a single setting. Twelve pre-selective spindle speeds cover a range of from 325 to 4050 rpm. Each spindle can be set to operate at the best speed commensurate with good finish, longest tool life, and fastest production rate. Precision depth control is also provided for each spindle and is pre-selective and automatically indexed with the turret for each spindle.

Sensitive feeding is provided by either control handles or a large handwheel which permits the operator to feel his way through a delicate machining operation. This feeding arrangement is said to produce excellent results and reduce tool breakage of fine tools to a minimum. The Model 1 C turret drill has a 14- by 24-inch table with T-slots and coolant trough. The spindle travel is 7 inches and the maximum clearance, 28 inches from spindle nose to extra low table. The machine is powered by a 1-hp, two-speed, 60-cycle motor.

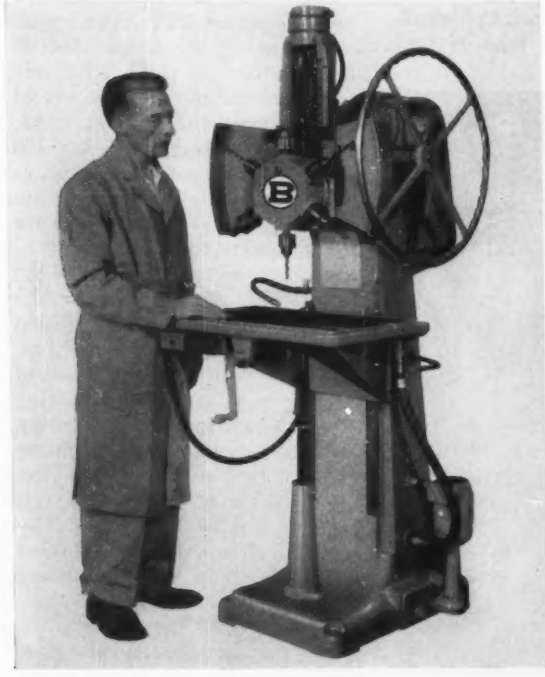
Circle Item 577 on postcard, page 199

Minster Deep-Throat Punch Presses

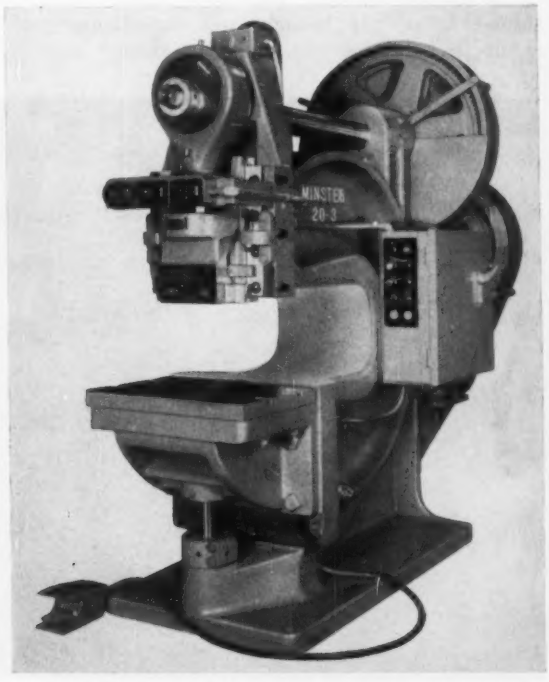
Series 20 deep-throat type punch presses, built in capacities of 15, 25, and 35 tons for light and medium punching, cutting, and flanging on large pieces, have been announced by the Minster Machine Co., Minster, Ohio. These presses feature a heavy section, one-piece, high-alloy cast-iron C-frame which forms a deep throat that allows punching to the center of a 60-inch circle. Two extra long, accurately ground, removable gibs guide the slide. Standard construction includes removable-slide punch caps and cross-bar knockouts.

Single gearing is available to provide slower operating speeds. Cast-iron main gears with H-section spokes and steel pinions are standard. These presses can be equipped with an adjustable bed when varying die space is needed. The patented Minster combination air friction clutch and brake is used on all three presses in the series. Advantages of this unit include inching the punch down to a center mark prior to tripping; smooth, high-speed engagement; and minimum wear.

Circle Item 578 on postcard, page 199



Burgmaster turret drilling, boring, and tapping machine



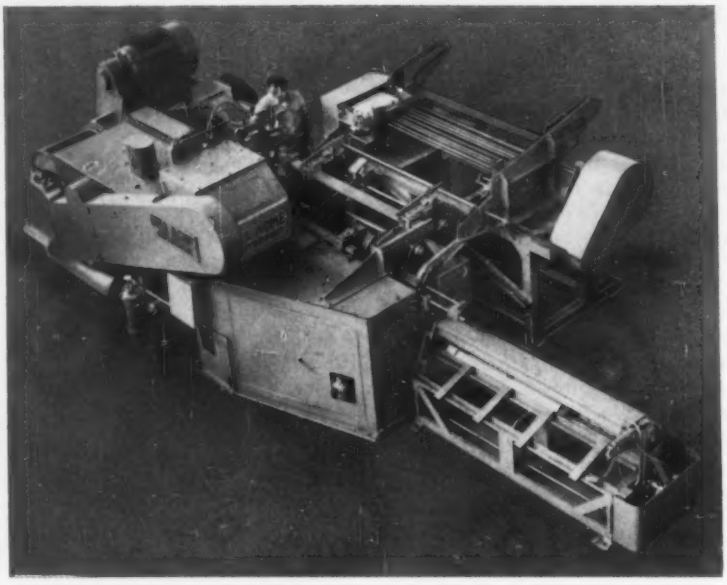
Deep-throat punch press built by the Minster Machine Co.

Hill Acme Automatic Forging Machine

The Hill Acme Co., Cleveland, Ohio, has developed a fully automatic forging machine, integrated with an induction heater, as shown in the illustration. This equipment will produce 5/8- and 3/4-inch mine-roof bolts in lengths from 12 to 72 inches at the rate of forty-five pieces per minute in sustained operation. The rods, already threaded at one end, are loaded into the feeding rack where a chain-driven index-feed positions them for proper spacing in the induction furnace.

As their ends are heated, the rods are delivered at the proper timing cycle to the forging machine by a roller-chain feed where they are gaged for length, picked up by fingers, and then passed progressively through the four-position die. The finished forgings are discharged at back of machine.

The design of this automatic forging unit does not limit the number of die positions or the length of stock to be used in forging a variety of parts. Pieces longer than 36 inches are supported by a walking beam through the various passes. These units are built in 1 1/4- to 5-inch capacities, all of which can be automated.



Automatic bolt-forging machine developed by the Hill Acme Co.

Circle Item 579 on postcard, page 199

Monarch Precision Radius-Checking Equipment

The Monarch Machine Tool Co., Sidney, Ohio, has brought out radius-checking equipment designed to facilitate the accurate machining of hemispherically shaped parts. This type of work requires precise control of many factors. Not the least of these is the radius of the cutting-tool edge. Inaccuracies in this radius will produce inaccuracies in the work-piece relative to the template. In hemisphere turning, the cutting section of the tool radius varies over a 90-degree range between the axis and the equator of the part. Therefore, all variations from a true radius are transmitted directly to the work-piece. This problem is a serious one for users of highly refined turning equipment, such as the Monarch Series 180 ultra-precision contouring lathe, as well as for those who employ numerically controlled machines for superaccurate contouring.

Precision radius-checking equipment introduced by Monarch Machine Tool Co.

The precise measurement of the tool-nose radius can now be achieved on the Monarch precision radius-checking instrument illustrated. This instrument consists of a main frame, as means for holding and positioning the measuring head, and provisions for mounting and adjusting the tool. An electronic checking device, which is not supplied by Monarch, is also required. The Monarch checker may be equipped for the recording of tool contours on a direct-reading oscillograph.

The tool is mounted on a vertical slide on the main frame, where it may be positioned in the correct

relationship to the measuring head. A set of five checking balls is provided for use as standards. They are mounted on shanks and include sizes 1/16, 1/8, 1/4, 3/8, and 1/2 inch in diameter.

In using this equipment the electronic measuring head is clamped in its bracket on the slide. A ball of the radius corresponding to the tool nose radius to be measured is then mounted in the tool-holder slide. By adjustment of the two lower slides, the axis of the upper-slide support bearing is so located that it passes directly through the center of the ball. This is achieved by making corrections as indicated by the electronic checking device, which is also used when the radius is established by means of the micrometer dial. When the checking device stands steady as the measuring head is swung around the precision ball, it is certain that the radius setting is accurate.

Next, the precision ball is replaced by the tool, which presumably has the same nose radius. The height of the tool is adjusted and the axis of the upper-slide support bearing is located through the center of the tool radius by adjusting the two lower slides. With the measuring head set at the known radius, the true nose radius of the tool can be measured.

If the radius dimension differs from that of the standard ball, the precision micrometer head is adjusted to determine the amount of error. Should the nose of the tool be other than a perfect radius, deviations are read on the electronic indicating device. Location of these deviations can be recorded with respect to the angular position of the measuring head.

Circle Item 580 on postcard, page 199

Snyder Rotary Index Machine for Processing Carburetor Pads on Intake Manifolds

A special five-station, rotary index machine that mills, drills, countersinks, spot-faces, and taps the carburetor pads in three different truck-engine intake manifolds has been designed and built by the Snyder Corporation, Detroit, Mich. This machine handles the manifolds at the rate of 109 pieces per hour at 100 per cent efficiency. To obtain the versatility to accommodate this variety of parts, three different design features have been incorporated in the machine. These include: (1) a two-position drilling unit with a two-position, single-spindle drill head; (2) interchangeable pot heads; and (3) a two-spindle tapping head in which only one of the spindles is used at a time for a given part.

The machine consists of an assembly of standardized modular components including a 60-inch-diameter table with a fluid drive index mechanism, wing bases, vertical columns, way type slide units, and milling, drilling, and tapping heads with lead-screw drives. A separate motorized unit provides power for this hydraulically operated, electrically controlled machine which is equipped with a push-button control panel.

At the first station, an intake

Snyder rotary index machine that utilizes three different methods to handle a variety of intake manifolds

manifold is clamped in one of the work-fixtures by a hydraulic cylinder. The carburetor pad is milled in the second station. At the third station, three or four holes are drilled in the face of the pad and one angular hole is drilled in the side of the manifold. The hole in the side has a different angular location and height in each of three different parts. This variation is handled by a two-position drilling unit with a two-position, single-spindle drill head. The different numbers and sizes of holes in the pad surfaces are accommodated by three interchangeable pot-heads.

The drilled holes are countersunk and one hole in one of the parts is both spot-faced and countersunk in Station 4. Three different interchangeable pot heads permit these part variations. The drilled holes in the pad face and the hole in the side are tapped in the fifth station. The head for the side hole has two spindles, one of which is used for two parts and the other for the third. Differences in pad-face tapped-hole spacing and size are taken care of by a third set of three interchangeable pot heads.

The processed part is unclamped at the first station by a hydraulic cylinder at the opposite side of the fixture from the cylinder used for clamping.

Circle Item 581 on postcard, page 199

Weingarten Transfer Presses

The Cosa Corporation, New York City, is introducing a new line of Weingarten transfer presses, available in six models ranging from 50 to 150 tons capacity and having from five to ten tool stations. These presses feature quick tool interchangeability and are especially suited for small-lot production work. They are fully automatic in operation, being fed from a stack of pre-cut blanks or a roll of strip material. Strip material is utilized most economically through a zigzag feeding mechanism.

All of these transfer presses are equipped with individually adjustable pneumatic cushions for dies—triple cylinders for each tool station. An adjustable transfer gripping device feeds parts from station to station. The cranks are driven by herringbone gears. All presses can be equipped with an infinitely variable drive, and can be supplied with complete tooling.

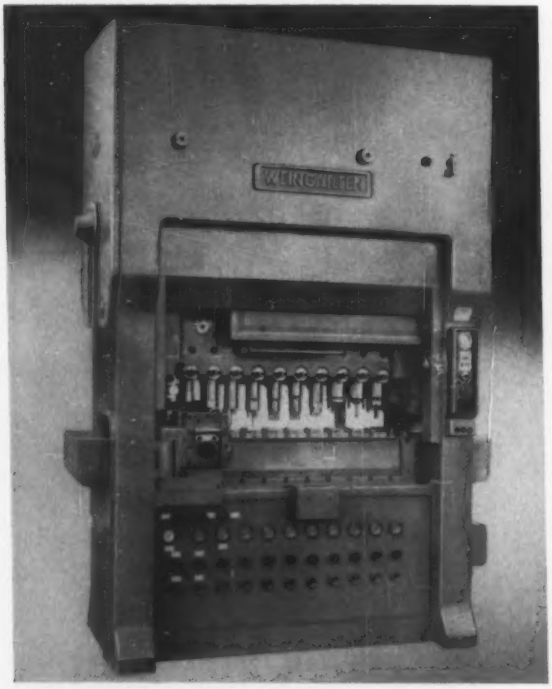
Circle Item 582 on postcard, page 199

Hydraulically Operated Dual Riveter

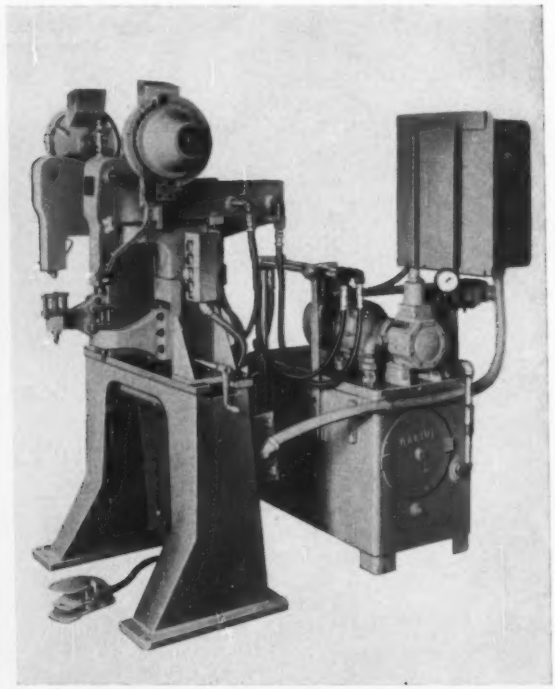
The introduction of a dual riveter using hydraulic power as the motivating force and which can be adapted to a wide range of setup requirements has been announced by the Tomkins-Johnson Co., Jackson, Mich. The Model HDR dual "Rivitor" illustrated is complete with all hydraulic and electrical equipment and controls. Specifications on this riveter include two riveting stands with 8-inch throat depths that are adjustable to spacings of from 1 1/2 to 18 inches center to center.

The HDR riveter is tooled to set two 1/4-inch diameter solid steel rivets that are gravity fed from two 10-inch hoppers. The operating cycle is about 0.8 second at 420-psi oil pressure when setting two 1/4-inch rivets. Maximum operating pressure is 1000 psi. Equipment conforms to JIC specifications.

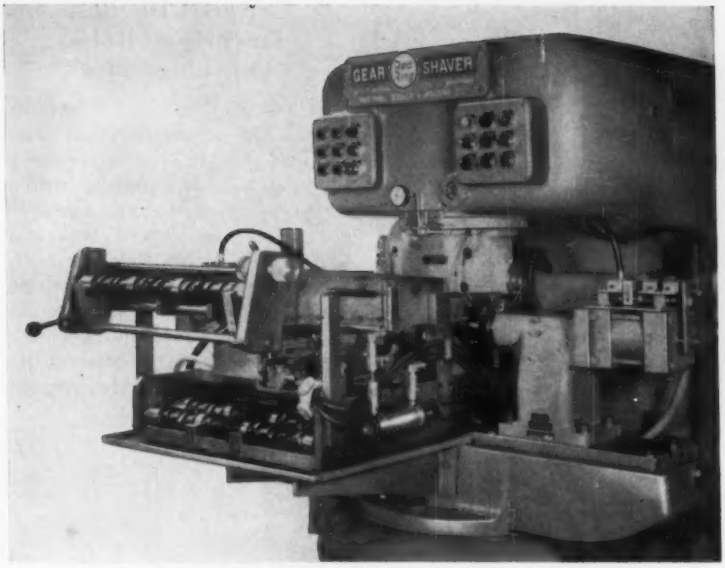
Circle Item 583 on postcard, page 199



Transfer press for short-run work introduced by the Cosa Corporation



Dual riveter using hydraulic power announced by the Tomkins-Johnson Co.



Red Ring slide type loader for handling long, slender parts on gear-shaving or gear-honing machines

Red Ring Automatic Loader for Long, Slender Parts

A Red Ring slide type, fully automatic loader for handling long, slender parts on gear-shaving or gear-honing machines has been announced by the National Broach & Machine Co., Detroit, Mich. This equipment features an air-cushioned exit motion and an air-powered steadyrest. Parts such as automotive camshafts are placed in the inlet magazine of the loader and pass through a pair of gaging master gears to check for any oversize condition of the gear to be shaved or honed. In the inlet magazine, the gears are spaced apart (to avoid nick damage) by a series of linkages that automatically advance each shaft as it is fed into mesh with the cutter or honing tool for the finishing operation.

Air-powered headstocks and tailstocks advance centers into each end of the shaft. When a part is in the finishing position in mesh with the gear-shaped tool, an air-powered steadyrest is raised to contact one of the bearings in the middle of the camshaft. The steadyrest is then raised to a positive stop and locked in position while the gear teeth are being finished. When the operation is completed, the steadyrest moves downward and an air-cushioned mechanism lowers the camshaft into the exit chute of the loader.

With this type of automatic loader, the operator need only keep the magazine full of parts and remove the finished ones.

Circle Item 584 on postcard, page 199

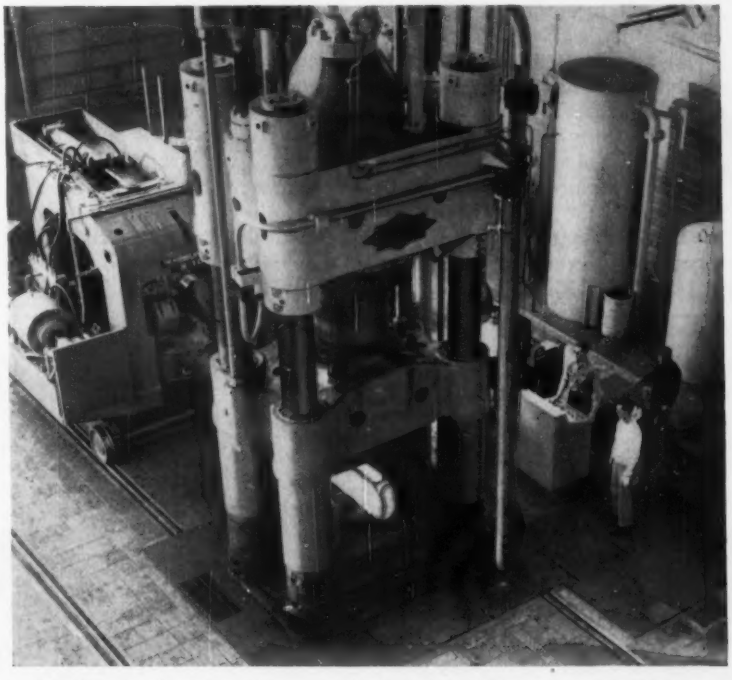
Hydraulic Press for Forging 10,000-Pound Billets

A 2000-ton water-hydraulic forging press, designed to minimize the effects of deflection due to off-center loading, is being used to forge super-alloy billets at the plant of the Haynes Stellite Co., Division of Union Carbide Corporation, Kokomo, Ind. This forging press, designed and built by Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa., handles extremely tough, super-alloy billets in a weight range of from 1500 to 10,000 pounds. It is fast-acting and capable of one hundred twenty 1/2-inch planishing and thirty-five 3-inch cogging strokes per minute. Two 600-hp seven-plunger pumps maintain pressure in the hydraulic accumulator system at 4500 psi.

The forging operation is invariably off-center up to 3 inches or more. The resulting deflection is minimized in its effects, however, by the use of heavy-duty tie-rods.

The press is operated from a main control console by one operator who has finger-tip control over planishing. The cogging, or main forging operation, is done by means of a manual operating lever.

Circle Item 585 on postcard, page 199



Birdsboro hydraulic forging press designed to withstand off-center loading

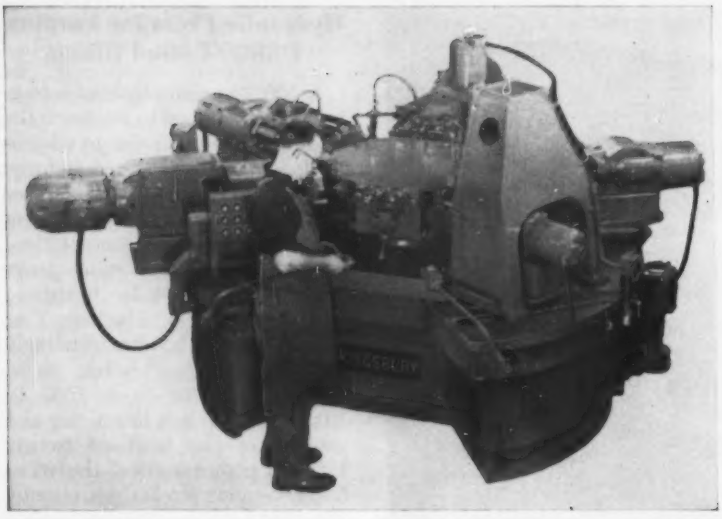


Fig. 1. Multiple-unit automatic machine for processing bearing-plate castings

Multiple-Unit Automatic Machine for Processing Bearing-Plate Castings

An automatic machine has been built by the Kingsbury Machine Tool Corporation, Keene, N. H., for use in processing bearing-plate castings for air-conditioning units at the Louisville, Ky., plant of the General Electric Co. Six units with fifteen spindles drill, counterbore, ream, trepan, and butt-mill the bearing-plate castings at a gross rate of 200 per hour. A 26-inch index-table holds six double-chucking work fixtures with a double equalizing clamp. A cover over the fixtures, as seen in Fig. 1, keeps the chips out.

In each chucking the plate is located vertically with a supporting plug in the center bore. For the first chucking in the left half of the fixture, the hub of the workpiece, Fig. 2, extends outward, and rotative location is taken from the contour of the plate. For the second chucking in the right half of the fixture, the hub of the workpiece, Fig. 3, faces inward. One reamed hole passes over a pin.

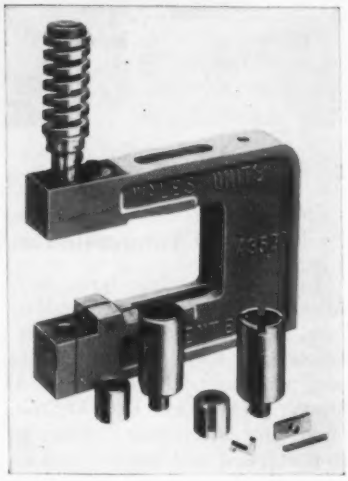
The vertical unit in the rear drills the 0.120-inch hole. One horizontal unit butt-mills a half-hole in the hub. The other four horizontal units have multiple-spindle auxiliary heads and operate on parts in both chuckings. In the first chucking they drill seven holes and ream two of them. In the second chucking they drill, counterbore, and ream one 3/4-inch hole and trepan the center bore. Bushings guide each tool.

Circle Item 586 on postcard, page 199

Fig. 2. (Left) Casting machined in first chucking on machine shown in Fig. 1
Fig. 3. (Right) Casting machined in second chucking on multiple-unit machine

Universal Die Base for Strippit Hole-Punching Units

Wales-Strippit, Inc., Akron, N. Y., has announced that their Strippit Type "CJ" hole-punching units can now be equipped with a new type of die base designed to cut replacement costs of round and shaped dies by about 50 per cent. These bases are interchangeable with the previous one-piece pedestal dies. It is now only necessary to replace a relatively low-cost die button, which is readily inserted and locked in the top of the die base by a set-screw. Die bases for shaped die buttons are keyed to the Type "CJ" holders and have keyslots at 90-degree intervals.

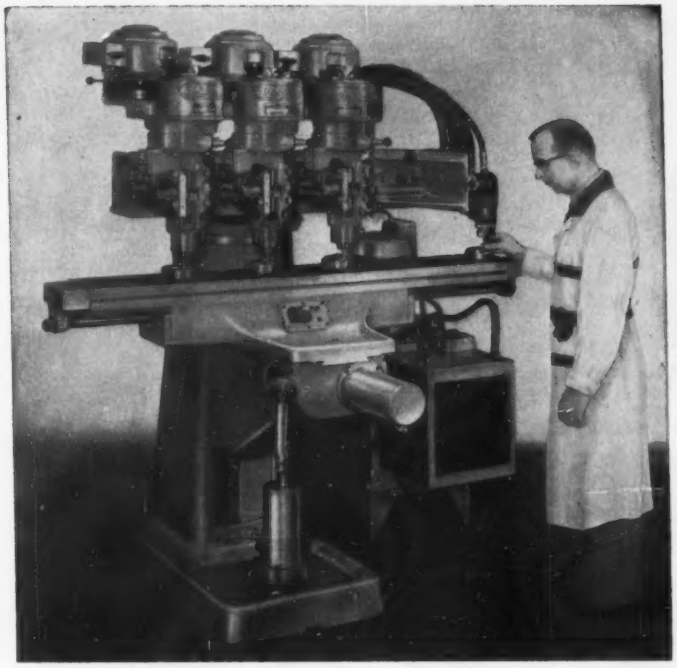


Strippit Type "CJ" hole-punching unit and accessories

The bases are made of heat-treated alloy tool steel and have a wide base area which provides rigid support for all punching up to the maximum 1/4 inch capacity in mild steel. Made to fit all high die-block "CJ" units, the new assemblies maintain the original unit dimensions for punching close to the inside of angles. The illustration of the Strippit Type "CJ" hole-punching unit shows (front, left to right) round die button, base for round die buttons only, shaped die button and key, die base with key, and retainer pin for either round or shaped die buttons.

Circle Item 587 on postcard, page 199

(This section continued on page 166)



Solve Your Duplicating Problems

with the

Bridgeport

HYDRAULIC TRACING MACHINE

. . . for economy, performance, easy operation and speed

(Left) 3D T-Ram machine with 3 milling attachments. Also available with 2 attachments.

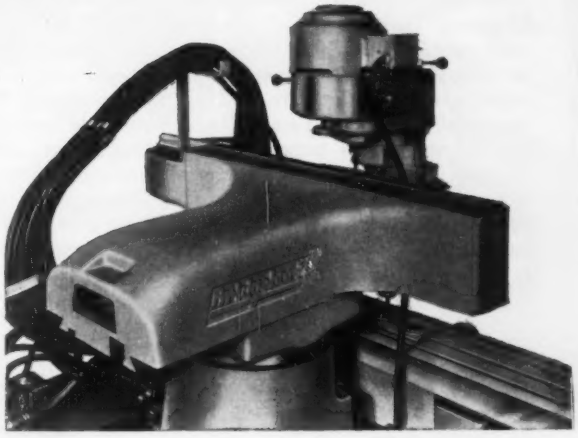
(Below) T-Ram applied to 3D Duplicating machine greatly increases its capacity.

This recent development converts the BRIDGEPORT MILLER into a duplicating machine unexcelled for accuracy, speed and ease of operation. It is designed integral with the basic machine and provides simultaneous, multiple-piece production in a single operation. Identified as the BRIDGEPORT T-Ram Tracing Machine, it is available in three models as follows:

1D . . . 180° with vertical 4″ feed hydraulic piston movement of knee.

2D . . . 360° with cross and longitudinal feed. Table longitudinal movement 28″; saddle transverse movement 12″.

3D . . . with vertical, cross and longitudinal feed. Hydraulic movements: Knee 4″; Table 28″; Saddle 12″.



Ways on all models are chome plated for maintained accuracy, smooth operation and minimum wear. A one-shot lubricating system is provided. The inherent sensitivity and accuracy of the 3D machine is achieved by combining good design with proper application of the universally-accepted True-Trace 3D valve.

Ask for more complete details from us or from your nearest dealer.

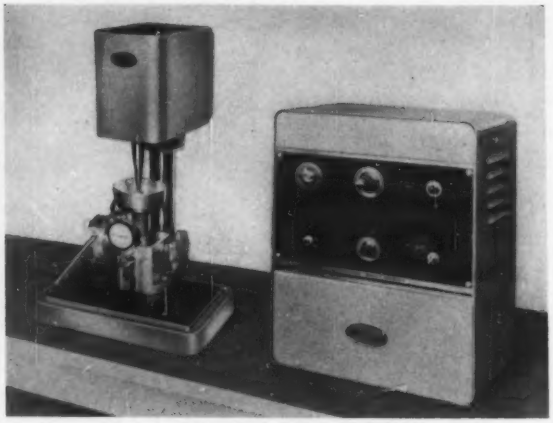
Bridgeport MACHINES, INC.

Bridgeport, Connecticut

Manufacturers of High Speed Milling Attachments and Turret Milling Machines

For more data, circle this page number on inquiry card

Imperial high-precision inclinable indexing table introduced by Opto-Metric Tools, Inc.



Raytheon ultrasonic impact grinder using magnetostrictive transducer to permit 100-per-cent-duty cycle

Inclinable Indexing Tables

A full line of Imperial high-precision inclinable indexing tables is being offered by Opto-Metric Tools, Inc., New York City. These tables are imported from West Germany. They are available in six sizes ranging from 10 to 32 inches in diameter. Because of their extreme precision, they are said to be equally well suited for jig-boring, assembly, and inspection operations. A circumferential correction cam assures an indexing accuracy of 10 seconds of arc. A certificate of proof in 5-degree intervals is furnished with each table.

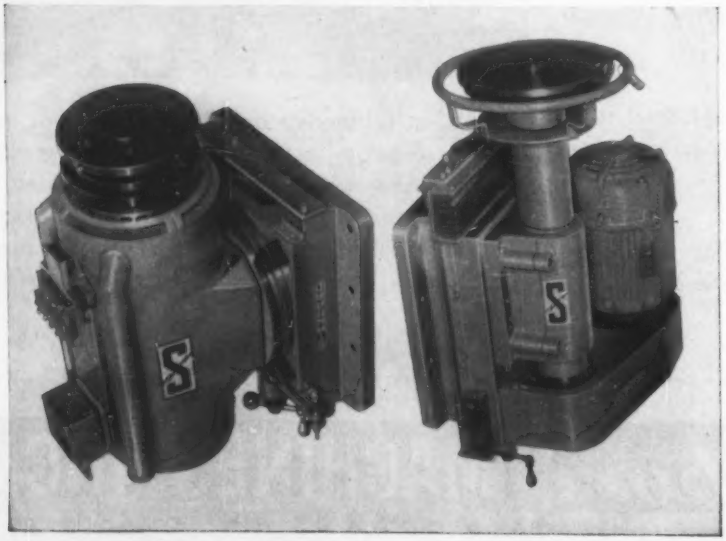
Circle Item 588 on postcard, page 199

Ultrasonic Impact Grinder

An ultrasonic impact grinder using a magnetostrictive transducer to permit a 100-per-cent-duty cycle is announced by the Industrial Equipment Department, Raytheon Mfg. Co., Waltham, Mass. This Model 2-335 grinder has been brought out to meet the need for a low-cost unit. It is simple, rugged, versatile, and can be used for cutting, slicing, drilling, grinding, and trepanning regular or irregular shapes in materials such as semiconductors, ceramics, ferrites, carbides, metals, jewels, and other hard or brittle materials.

The cutting head is mounted on a rugged base, has cutting force adjustment and a built-in force indicating dial. The slurry tray is readily removed for cleaning, and tool cones can be interchanged easily. The ultrasonic driver produces 100 watts.

Circle Item 589 on postcard, page 199



Electrolytic spindle units for machining tough metals developed by Standard Electrical Tool Co.

Electrolytic Spindles for Machining Space-Age Metals

Super-precision spindles of the type shown in the accompanying illustration have been brought out by the Standard Electrical Tool Co., Cincinnati, Ohio, for electrolytic metal removal or grinding of the so-called "space metals." Horsepower and speed capacities of these units vary from 1 to 20 hp and 600 to 7600 rpm, depending upon the character of work, size and type of wheel, etc. In some instances, multiple-speed, direct motor drives, or variable-speed, belted motor drives provide the versatility required. Design and construction of the spindle permit use of direct-current power supply, ranging from 50 to 3000 amperes.

The electrolytic removal of the metal is accomplished by means of a power supply that converts alternating current from an ordinary power source to low-voltage, high-amperage direct current.

The No. 2000RLY unit shown at the left is designed for a 600-ampere, direct-current power supply. It is equipped with a 5-hp, 1800-rpm, alternating-current motor, belted drive with speed change to

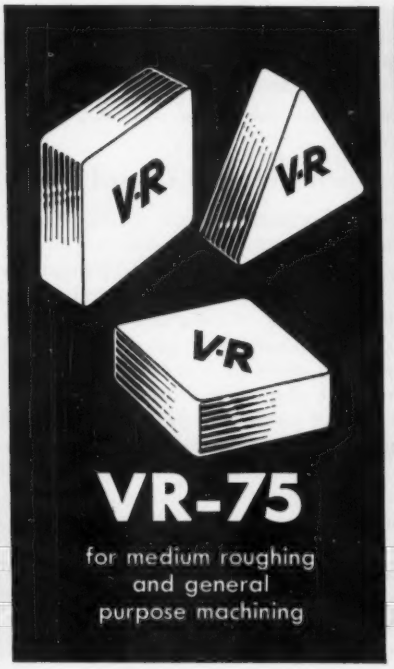
You wouldn't play right field with a catcher's mitt . . .

playing ball or cutting steel,

use the "tool" designed for the job!

VR-77

for heavy roughing and interrupted cutting



VR-75

for medium roughing and general purpose machining

VR-73

for finish machining and light roughing

Each carbide grade has been specially engineered and field proven for the correct balance of wear resistance, shock resistance and heat resistance to handle a specific range of operations. These superior V-R carbide grades cover the complete range of operations for machining all types of steel and the new superalloys . . . setting new standards of carbide tooling performance in hundreds of plants. V-R engineers will be glad to help you select the carbide grade engineered for your job. Contact your nearest V-R representative or write for complete information.

Ask for Bulletin No. 5803 on V-R grades

V-R Vascoloy-Ramet corporation

PRIME MANUFACTURERS OF REFRACTORY METALS ENGINEERED FOR THE JOB

C-744

804 Market Street • Waukegan, Illinois

satisfy 6-, 8-, 10-, 12-, and 14-inch straight or cup grinding wheels. Each backing plate for the cup-wheel also involves the sprinkler-spider for introducing the salt solution at the perimeter and internal recess of the cup-wheel. The spindle assembly on the vertical feed provides for a 9-inch traverse parallel with the spindle.

Model No. 6028LY shown at the right is a 7 1/2-hp, direct-driven, alternating-current motorized unit of variable-horsepower constant torque, with four speeds—3600, 1800, 1200, and 600 rpm. The slip-ring of the spindle is designed for 3000 amperes power supply. This is a versatile unit, suitable for mounting circular well adapter-plates for cup-wheels, but is illustrated with wheel holder to mount straight grinding wheels. A 360-degree swivel base is assembled between the motor base and the feed base or slide. Wheel sizes for this four-speed unit range from 6 to 18 inches in diameter for cup-wheels and 14 to 20 inches in diameter for straight wheels.

Electrolytic metal removal is now accomplished on all kinds and sizes of new and existing machine tool equipment. These machine tools are rapidly being converted with standard, super-precision electrolytic spindles. The adaptations range from typical tool and cutter grinders, surface and vertical grinders, vertical and horizontal milling machines, open-side shapers, planers, and boring mills to planer type milling machines.

Circle Item 590 on postcard, page 199

Lamb Interlocks for Coordinating Flow of Chuted Parts

Two versatile interlock units for controlling and coordinating the flow of chuted parts in manufacturing installations using automatic handling systems have been announced by F. Jos. Lamb Co., Detroit, Mich. The units can be mounted on Lamb FabriFlex chuting without alterations and can also be used on most chuting configurations of open design.

The standard line switch interlock indicates parts accumulation at a given point and produces an electrical signal which can be used to control any machine, fixture, or handling function. The shot bolt interlock permits or prevents part flow and can be operated automatically or manually from a remotely located push-button. With the solenoid or pneumatically operated stop-bars arranged to deflect parts into outlet chutes, multiples of this unit can be used to distribute and feed parts to as many as five machines.

Operating life of the line switch is greatly extended by the adjustable counterweight which actuates the switch. It can be adjusted for actuation by the weight of one part or the accumulated weight of two or more parts.

Both the line switch and shot bolt interlocks are installed on-site to meet field conditions and can be relocated in minutes without chute alterations. Both units are made in five models that handle parts in sizes having cross-sectional areas up to 6 by 4 inches.

Circle Item 591 on postcard, page 199

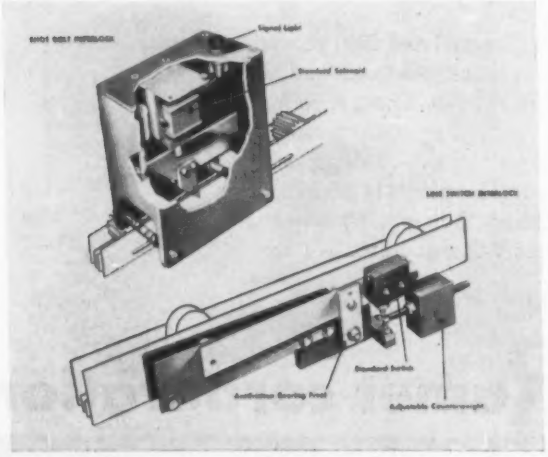
Jarvis Carbide Boring-Bar

A carbide boring-bar designed for use in jig borers and lathes, which is said to incorporate quality features at a comparatively low initial cost and to offer substantially reduced replacement costs, has been brought out by the Jarvis Corporation, Middletown, Conn. Called the "Bor-Bar," this accurate, smooth-cutting, chatter-free tool has an extra-wide solid carbide bit brazed to the shank. The bit is lapped to a microfinish, radially relieved, and designed to permit a maximum number of regrinds. The tough steel shank is ground to close tolerances.

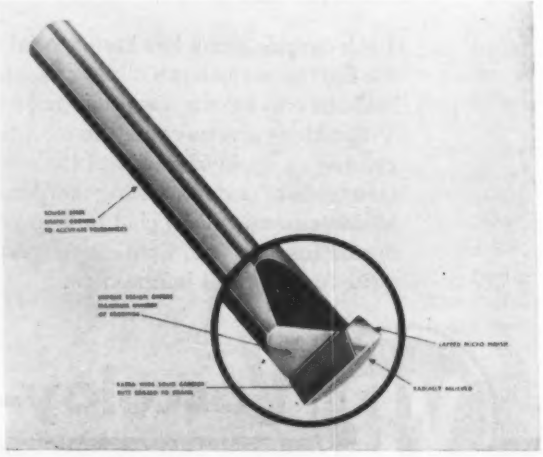
No special fixtures are needed for regrinding this tool, only a simple V-block and diamond wheel being required. The boring-bar is furnished relieved for either ferrous or non-ferrous materials. Stock sizes are available in the following range of sizes: minimum hole diameters, 3/8 to 1 inch; shank diameters, 1/4 to 3/4 inch; and lengths, 2 to 6 inches.

Circle Item 592 on postcard, page 199

(This section continued on page 175)



Two accessories for automated parts-handling systems recently announced by F. Jos. Lamb Co.

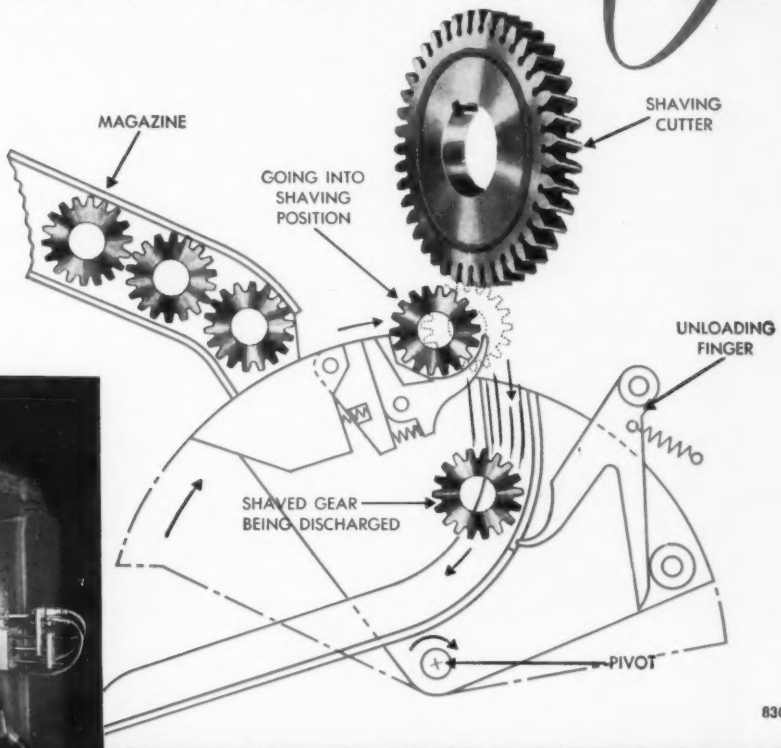


Boring-bar for use in jig borers and lathes introduced by the Jarvis Corporation

WHY SETTLE FOR ONLY 75%

OF THE PRODUCTION YOU CAN GET WITH

AUTOMATIC GEAR SHAVING



RED RING ROCKER-TYPE AUTOMATIC LOADER
(PATENTED)

Production you can expect from automated gear shaving is determined by the type of automatic loader you use.

You get maximum production when the loader moves a gear from the magazine into shaving position and discharges its shaved predecessor — **all at the same time.** This assures maximum cutter operation.

If, on the other hand, the loading of a fresh gear has to wait until the previous gear has been discharged, shaving is delayed and you get only about 75% of the production you could otherwise expect.

The standard Universal Red Ring Gear Shaving Machine may be automated for MAXIMUM PRODUCTION — and without any major revisions in its design. Write for details.

SPUR AND HELICAL GEAR SPECIALISTS
ORIGINATORS OF ROTARY SHAVING, GEAR HONING AND ELLIPTOID

NATIONAL BROACH & MACHINE CO.

5600 ST. JEAN • DETROIT 13, MICHIGAN

WORLD'S LARGEST PRODUCER OF GEAR SHAVING EQUIPMENT

Now available on all Parker-Hannifin

STRAIGHT THREADS FOR LEAK-PROOF

Industry's new standard as published in J. I. C. Recommendations (April, 1959) and S. A. E. Standards (1959 Handbook)

Why accept less?

Parker-Hannifin now offers a new standard *at no extra charge*—high-pressure hydraulic components with straight thread port connections* for O-ring type fittings. This new standard—assuring a leak-proof and drip-free seal—is the most logical engineering approach to the problem of hydraulic circuit connections. The Joint Industry Conference Recommendations now state:

"Fittings that incorporate separate synthetic or metal-to-metal seals, or seal with pressure *should* be equipped with Unified National Fine (UNF) straight thread port connections."

And the Society of Automotive Engineers' 1959 Handbook states:

"The S.A.E. straight thread 'O'-ring boss is the preferred port for use in hydraulic devices."

Both support this new standard—and the U. S. Navy Bureau of Ships in MS16142 (SHIPS) has adopted the S.A.E. Straight Thread Boss Design as their straight thread standard for use in hydraulic and air systems in Naval ships. Such extensive support is understandable. The Parker-Hannifin straight thread port connections combine a built-in pressure sealing device with a rigid mechanical connection. This contrasts with the loose connection of a "backed-off" pipe thread and a relatively weak auxiliary sealing device.

Straight thread fittings and port connections are not a proprietary product or design. Although developed by Parker-Hannifin, they were immediately made available to the fluid power industry on a completely open basis.

They have been thoroughly field tested. In the severe service on mobile hydraulic equipment, today more than 6 out of 10 of the port connections are of the straight-thread type.

Now machinery builders and users alike are turning to this proved method of port sealing. Pipe threads for high-pressure hydraulic applications are fast becoming obsolete as more and more leading manufacturers recognize these advantages of straight threads in their production equipment:

No more wedging action with resulting distortion and breakage due to over-tightening . . .

No more messy pipe dope and the danger that it will infiltrate the hydraulic system . . .

No more leaks because of temperature changes or high shock conditions . . .

No more failures of costly auxiliary seals due to weak, imperfect threads that fit on thread run-out.

Why accept less? Next time you order high-pressure hydraulic components, specify Parker-Hannifin with straight thread port connections and fittings . . . you'll get leak-proof sealing—industry's recommended standard.

**Mobile equipment spool type control valves are all supplied with straight threads. Other components are still available with dry-seal pipe threads.*

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Parker FITTINGS AND HOSE DIVISION
17325 Euclid Avenue, Cleveland 12, Ohio

Parker SEAL COMPANY
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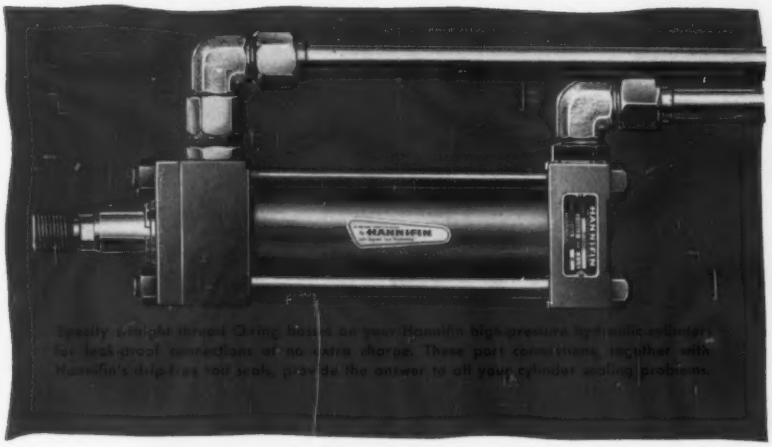
Parker HYDRAULICS DIVISION
17325 Euclid Avenue, Cleveland 12, Ohio

4 DIVISIONS OF PARKER-HANNIFIN CORPORATION

high-pressure hydraulic components

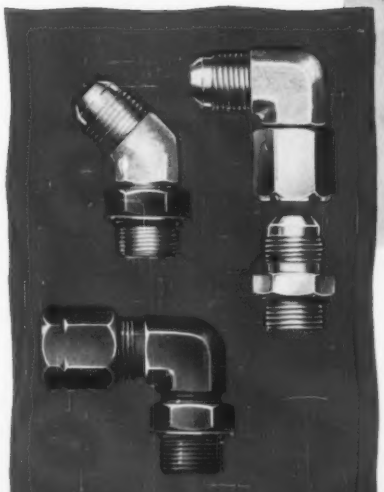
PORT CONNECTIONS...



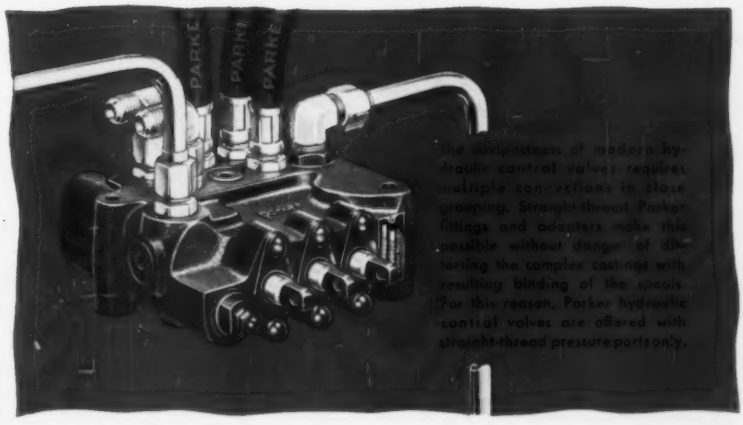
Specify straight-thread O-ring fittings on your Hannifin high-pressure hydraulic cylinders for leak-proof connections of no extra charge. These port connections, together with Hannifin's drip-free rod seals, provide the answer to all your cylinder sealing problems.

Both Parker's new "Krimp-lok" permanent-end hose assemblies and "Hose-lok" reusable fittings (as well as all adapters) are available with straight threads. O-ring sealed for any specified fluid.

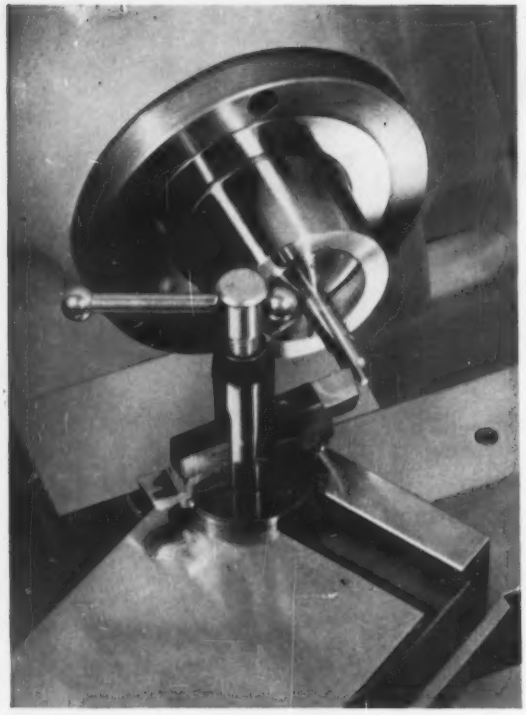
The O-rings used in Parker port connections are made only from service-tested Parker Seal Company compounds. With an ever-increasing number of fire-resistant fluids now on the market, it pays to avoid "jack-of-all-fluids" seals and stay with the Parker Seal compound specifically made for the fluid you will be using.



There's a complete line of Parker straight thread O-ring fittings and adapters for you to choose from . . . Triple-lok (flare type) and Ferulok® (flareless, bite-type). Either method assures you leak-proof, trouble-free hydraulic connections.



The compactness of modern hydraulic control valves requires multiple connections in close grouping. Straight-thread Parker fittings and adapters make this possible without danger of distorting the complex castings with resulting binding of the spools. For this reason, Parker hydraulic control valves are offered with straight-thread pressure ports only.



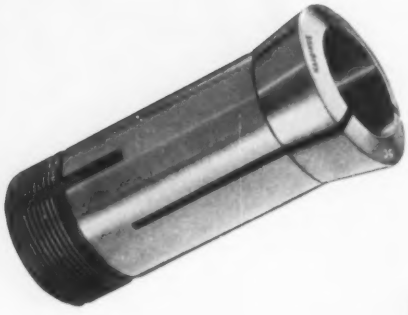
When

ACCURACY

REALLY COUNTS

SPECIFY:

HARDINGE



PRECISION DRAW-IN COLLETS

FOR YOUR

LATHES-MILLERS-GRINDERS

CARRIED IN STOCK FOR PROMPT DELIVERY IN:
Elmira, Boston, Atlanta, New York, Hartford, Philadelphia, Rochester, N. Y., Dayton, Detroit, Minneapolis, Chicago, St. Louis, Portland, Oakland, Los Angeles, Seattle, Toronto

HARDINGE BROTHERS, INC., ELMIRA, N. Y.

AMERICAN STANDARD DRIVING AND SPINDLE ENDS FOR PORTABLE AIR AND ELECTRIC TOOLS—7

(Percussion Tools Excluded)

Approved as American Standard October 29, 1958

IV. Abrasion Tool Spindles (Cont'd.)

4. Straight Wheel Grinders

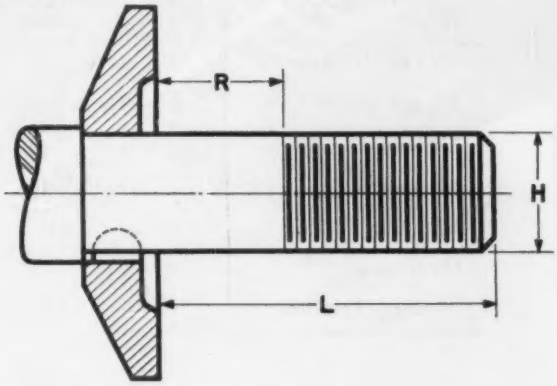


Table 8

H	*R*	*L*
3/8-24 UNF – 2 A	1/4	1 1/8
1/2-13 UNC – 2 A	3/8	1 3/4
5/8-11 UNC – 2 A	1/2	2 1/8
5/8-11 UNC – 2 A	1	3 1/8
3/4-10 UNC – 2 A	1	3 1/4

All dimensions in inches. Threads right-hand.
NOTE: For explanation of coordination with B7.1-56 and recommended wheel diameters, see Appendix B.

V. Circular Saw Arbors

1. Round Arbors

Table 9

Nominal Blade Diameter	Round Arbor Diameter
6 to 8 1/2 Incl.	5/8
9 to 12 Incl.	3/4

All dimensions given in inches.

Extracted from American Standard Driving and Spindle Ends for Portable Air and Electric Tools (ASA B5.38-1958), with permission of publisher, the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

AMERICAN STANDARD DRIVING AND SPINDLE ENDS FOR PORTABLE AIR AND ELECTRIC TOOLS—8

(Percussion Tools Excluded)

Approved as American Standard October 29, 1958

Appendix

A. Geared Chucks and Spindles

Chuck Sizes	Recommended Spindles	
	Threaded	Taper
3/16 and 1/4 light	3/8-24	1
1/4 and 5/16 Medium	3/8-24 or 1/2-20	2 Short
3/8 light	3/8-24 or 1/2-20	2
3/8 Medium	1/2-20 or 5/8-16	2
1/2 Light	1/2-20 or 5/8-16	33
1/2 Medium	5/8-16 or 3/4-16	6
5/8 and 3/4 Medium	5/8-16 or 3/4-16	3

B. Straight Wheel Spindles

Coordination with B7.1-56 and accepted practice of users indicate that grinders with pneumatic and induction electric motors should be designed for the use of organic bond wheels rated 9500 feet per minute (fpm). Light duty electric grinders may be designed for vitrified wheels rated 6500 feet per minute. Recommended maximum wheels of both types for each spindle are given in the following Table:

Spindle Size	Maximum Wheel			
	9500 fpm		6500 fpm	
	Diameter D	Thickness T	Diameter D	Thickness T
3/8-24 x 1 1/8	2 1/2	1/2	4	1/2
1/2-13 x 1 3/4	4	3/4	5	3/4
5/8-11 x 2 1/8	8	1	8	1
5/8-11 x 3 1/8	6	2	-	-
5/8-11 x 3 1/8	8	1 1/2	-	-
3/4-10 x 3 1/4	8	2	-	-

NOTE: Minimum T with the first three spindles is about 1/8 inch to accommodate cutting off wheels. Flanges are assumed to be according to B7.1-56 and threads to B1.1-49.

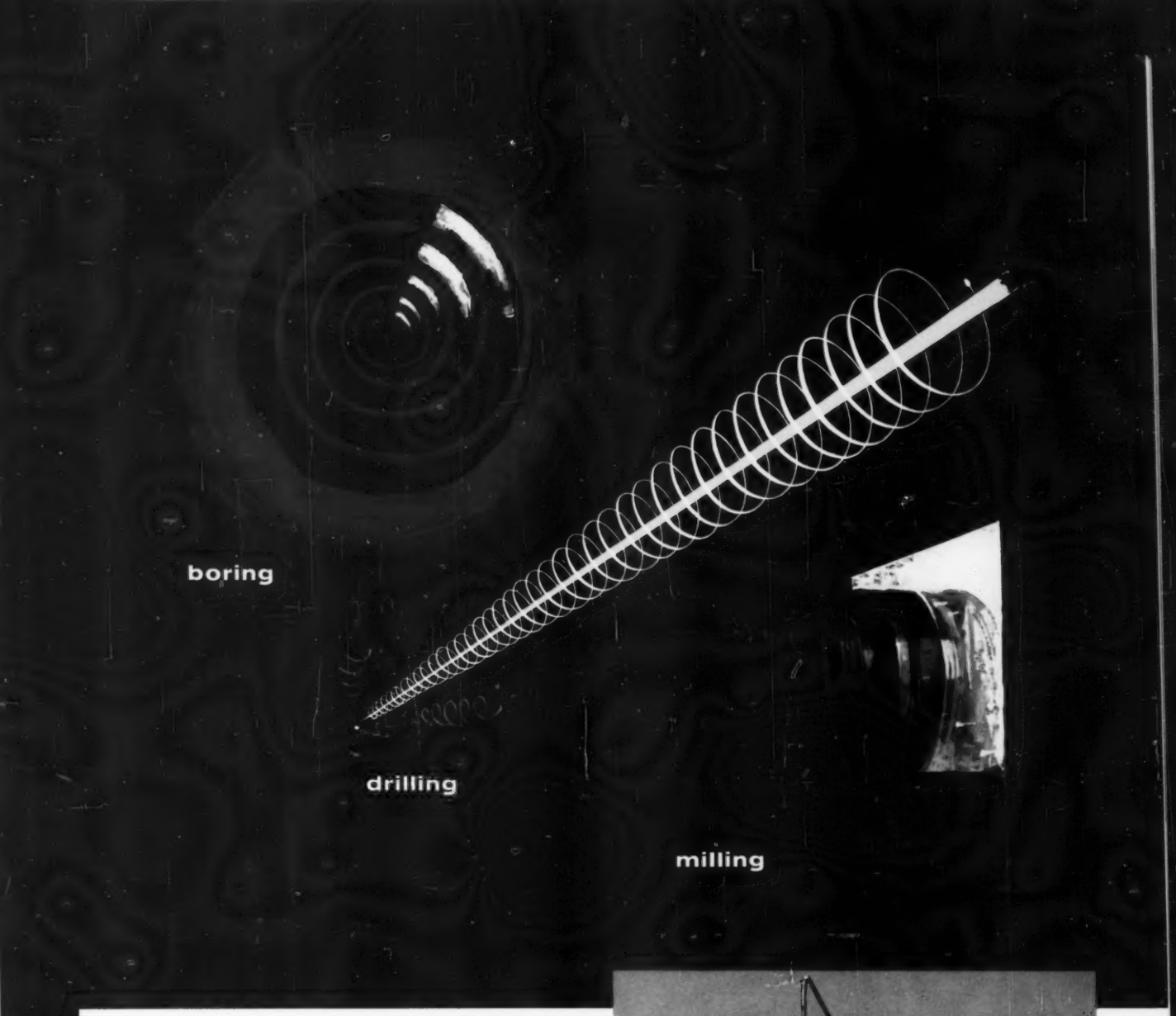
C. Vertical and Angle Grinders

This 5/8-11 spindle with a length of 1 1/8 is designed to provide for a jam nut with threaded cup wheels. When a revolving guard is used, the length of the spindle is measured from the wheel bearing surface of the guard. For unthreaded wheels with a 7/8 hole, a safety sleeve nut is recommended. The unthreaded wheel with 5/8 hole is not recommended because a jam nut alone may not resist the inertia effect when motor power is cut off.

All dimensions given in inches.

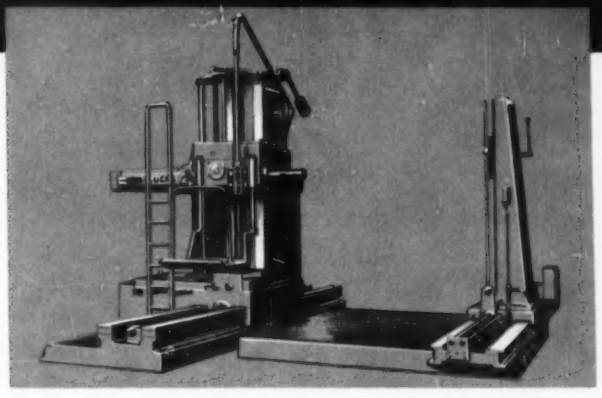
REFERENCES:
American Standard B1.1-1949—Unified and American Screw Threads.
American Standard B7.1-1956—Safety Code for Use, Care, and Protection of Abrasive Wheels.

Extracted from American Standard Driving and Spindle Ends for Portable Air and Electric Tools (ASA B5.38-1958), with permission of publisher, the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

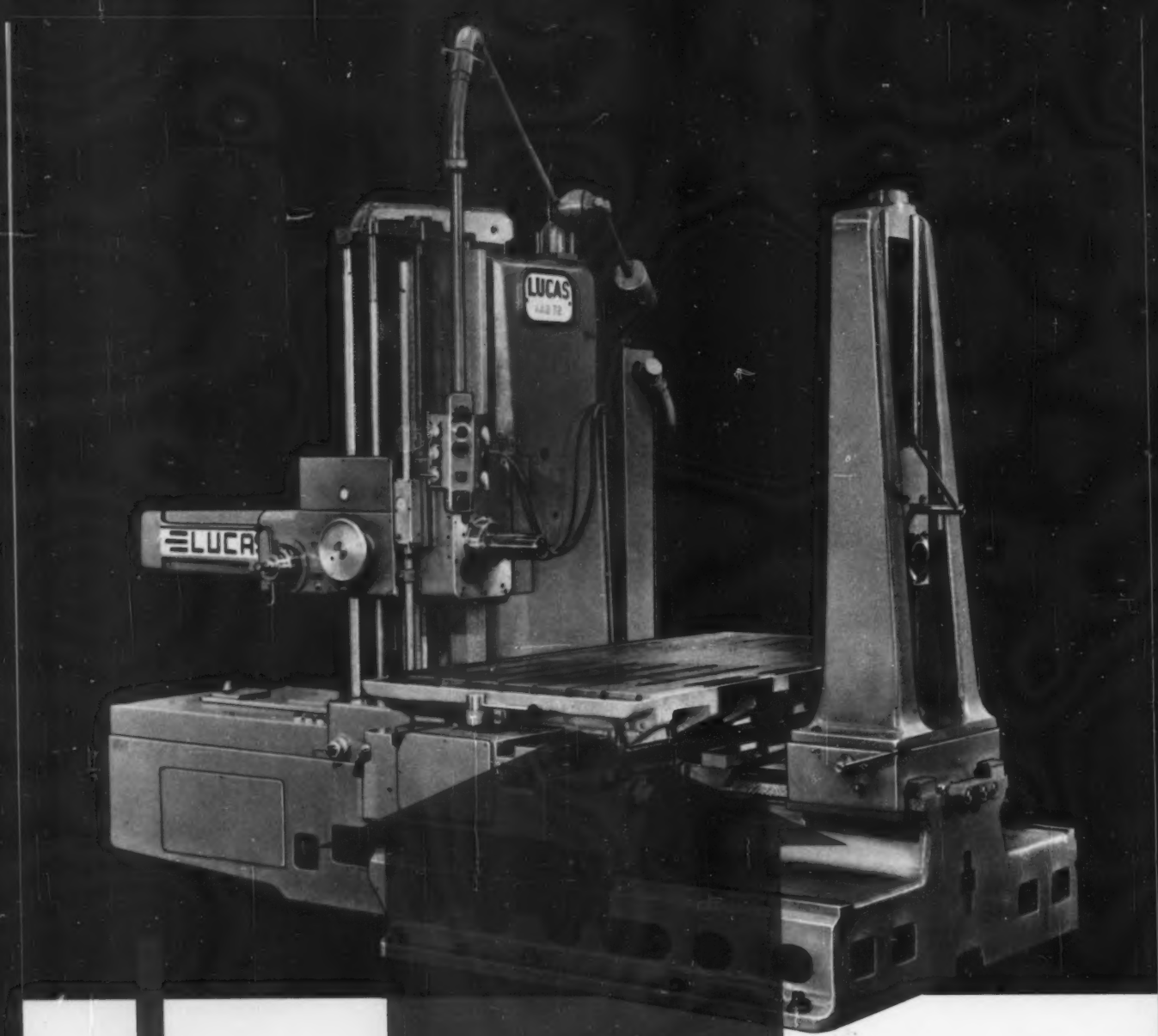


Floor type machines
YES!

A complete line of floor-type, horizontal boring, drilling and milling machines in the 4" and 5" spindle diameter range... with all the features and controls available in other Lucas models. Many of these are to be found *only* in a Lucas. *Did you ever meet a man who regretted picking a Lucas?*



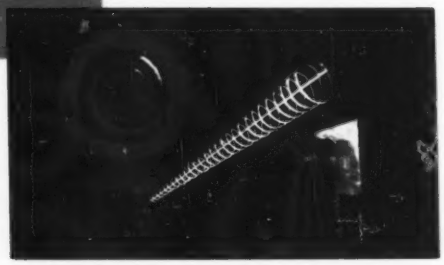
LUCAS
OF CLEVELAND



AIR LIFT*

to saddle and table

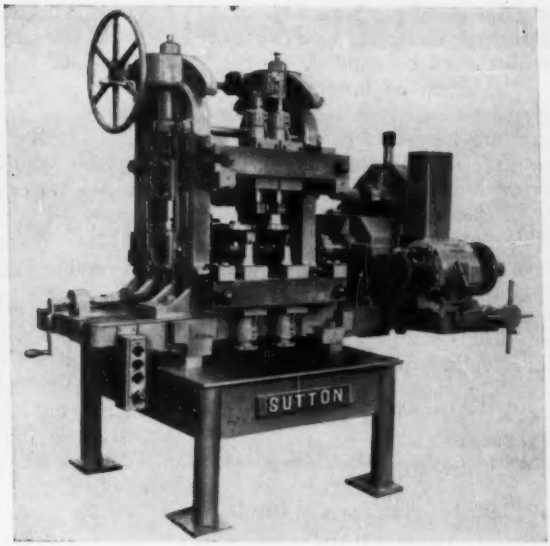
All Lucas components are fitted with the utmost precision. To insure lifetime accuracy, the saddle and table ride on lubricated compressed air . . . *ever so slightly above the surface of the ways.* Traverses, either feed or rapid, are silk-smooth and free of wear.



*Patent Pending

LUCAS
OF CLEVELAND

Fig. 1. Aircomatic Fillerarc rectifier type direct-current welder



Contour-correcting machine announced by the Sutton Engineering Co.

Airco Rectifier Welder and an Improved Spot-Welding Tip

A rectifier type Aircomatic Fillerarc direct-current welder (Fig. 1), and an improved, ejector type spot-welding tip holder (Fig. 2), have been announced by Air Reduction Sales Co., New York City. The welder features a rising-characteristic power source combined with the advantages of transformer-rectifier design. It is specifically designed for use with Aircomatic (Air Reduction's gas-shielded metal-arc) welding applications and has been developed to supplement the company's line of motor-generator type machines. Suitable for both manual and automatic welding, its primary advantage is stepless adjustment of arc length and rate of rise for various wire diameters.

Fig. 2. Tuffaloy ejector type spot-welding tip holder

The improved ejector type spot-welding tip holder, Fig. 2, consists of two major parts, held together by a coupling. A plated copper-alloy barrel and a brass head carry the water hose connectors. An ejector tube, assembled to the head, ejects the welding tip when the entire head is forced to slide into the barrel. All parts are easy to replace after unscrewing the coupling.

A threaded adapter which holds the tip is furnished as part of each holder. Made of RWMA Class 2 alloy, it reduces wear and distortion of the socket. Known as "Tuffaloy" Series "E" holders, they are made with barrels 8 and 12 inches long, in 1-, 1 1/4-, and 1 1/2-inch diameters, and to hold No. 1 and No. 2 Morse taper tips. Special sizes and special adapters are made to order.

Circle Item 593 on postcard, page 199

Sutton Contour-Correcting Machine

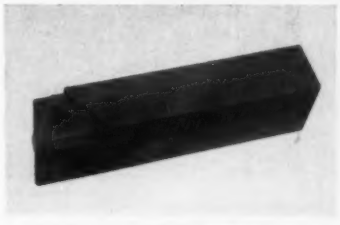
A patented contour-correcting machine designed to correct cross-sectional distortions of aluminum extrusions to extremely close tolerances is announced by the Sutton Engineering Co., Pittsburgh, Pa. Flat sections up to about 14 inches wide can be handled on this machine, and multiple corrections of shapes circumscribed by a 9-inch circle can be made in one pass.

The correcting mechanism consists of two main-drive spindles with rolls, which may be used for correcting as well as for traction, and up to eight correcting idler rolls, which may be positioned in many different ways on as many as twelve tool-holder positions. Thus, an almost infinite variety of shapes can be handled. After initial setup, tool-holders may be adjusted externally (both vertically and horizontally) to apply increased or decreased pressure. This feature cuts setup and change-over time considerably and is said to permit far more precise correcting than would otherwise be possible.

Circle Item 594 on postcard, page 199

Holders for Kendex Inserts

Holders for its new precision, screw-on type Kendex inserts are now stocked by Kennametal Inc., Latrobe, Pa. Typical applications of these screw-on inserts are small boring-bars and automatic tool-



Holder for screw-on Kendex inserts announced by Kennametal, Inc.

ing for small parts on which the standard clamped type Kendex tools cannot be applied.

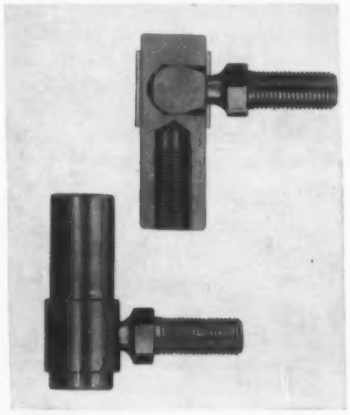
The screw-on inserts are held by flat-head socket cap-screws and are indexable to within plus or minus 0.001 inch. The insert screw hole is held central within 0.005 inch of all cutting edges. This permits positioning the insert against the recess shoulders, as the holder screw-hole is 0.015 inch oversize and allows the screw to "float." Sizes in stock include four right-hand and left-hand sizes for square, triangular, and round inserts. Five grades of inserts are stocked.

Circle Item 595 on postcard, page 199

Ball Joints Have Wide Applications

A patented ball joint developed by the Superior Ball Joint Corporation, Fort Wayne, Ind., is said to have double the life of previous conventional designs. The assembled joint also has fewer parts. It is available in a broad line of sizes with the thread at the ends ranging from No. 10-32 through 3/4-16. The ball departs from the conventional spherical shape, featuring a shorter, heavier neck that has greater shock resistance. Movement is free at any point in a minimum conical angle of 30 degrees regardless of the plane of deflection.

This ball joint is available for use in trucks and automobiles for steering, throttle, and carburetor control; in farm equipment; in all kinds of boats and ships; in aircraft; and in hundreds of other applications. The functional dimensions of these joints are interchangeable with SAE standards.

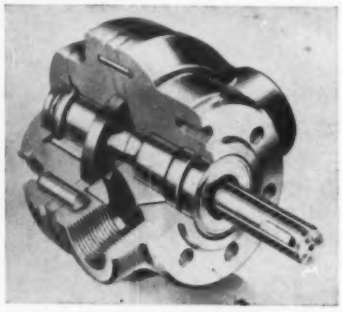


Ball joint for control applications developed by the Superior Ball Joint Corporation

Circle Item 596 on postcard, page 199

B & S Gerotor Pumps for Fire-Resistant Fluids

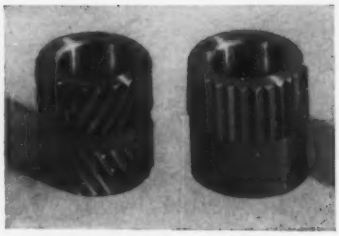
A Gerotor pump, Series 800, for use with fire-resistant fluids has been developed by the Brown & Sharpe Mfg. Co., Providence, R. I., for applications where fire hazards make the use of hydraulic oils dangerous, as in die-casting, welding, forging, etc. This series of Gerotor pumps has been life-tested on the job and accepted for preferred specification by some of the leading companies. In making the tests, proprietary water-soluble-oil emulsions were used, including both regular and inverse; ethylene glycol-water mixture; phosphate ester types, and high-temperature MIL fluids.



Pump developed by Brown & Sharpe for fire-resistant fluids

Series 800 pumps are currently available from stock in QDH-830 single-pump sizes having capacities of 3, 5, 8, and 12 gallons per minute. OG-860 single pumps are made in 20-, 30-, and 40-gallon-per-minute sizes. Any combination of 3-, 5-, 8- and 12-gallon-per-minute sizes are available in QGH-H-830 double-pump units. All Series 800 pumps are dimensionally interchangeable with regular Gerotor oil-hydraulic units of comparable capacities and with most oil-hydraulic pumps.

Circle Item 597 on postcard, page 199



Ex-Cell-O bushings for use in plastic jigs and fixtures

Bushings for Plastic Jigs and Fixtures

The Ex-Cell-O Corporation, Detroit, Mich., is introducing a line of drill-jig bushings for use in plastics. They were developed to meet the needs arising from the increasing use of plastics as a lightweight and inexpensive material for jigs and fixtures. These bushings are made of the same oil-hardening bearing steel used in standard bushings. Two basic types will be stocked, one for embedding in castable materials and one for pressing into holes in plastics, wood, or other soft ductile materials.

Ex-Cell-O Trans-Lok bushings (at the left in the illustration) for embedding in castable materials have serrations in a herringbone pattern around the outside diameter, with the opposed rows in the pattern separated by a groove. The deep transverse pattern and groove lock the bushing rigidly when it is embedded in the jig material. Trans-Lok bushings cannot be turned in either direction, nor pulled or pushed out of the jig. Liner bushings, for use when the jig will outlast the bushing or when more than one operation (for example, drilling and reaming) is performed in the hole, are also available in the Trans-Lok pattern. These liners are embedded in the plastic so that standard renewable bushings can be inserted in them to guide the drills and reamers.

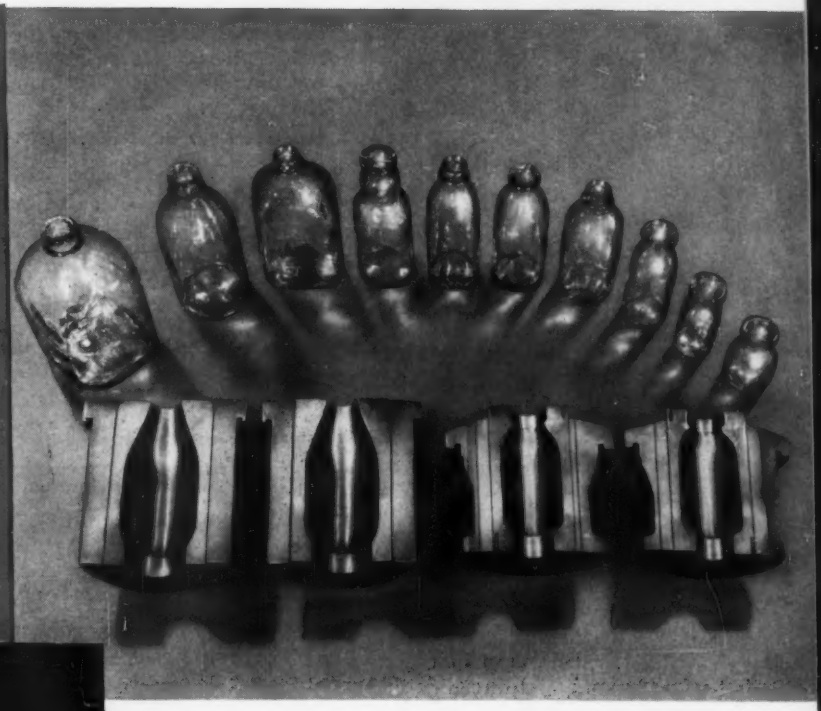
Ex-Cell-O Press-Lok bushings for plastics, like the one shown at the right in the illustration, have straight serrations on the upper half of the outside diameter. This permits them to be pressed firmly into holes in plastic, wood, or other soft or ductile materials.

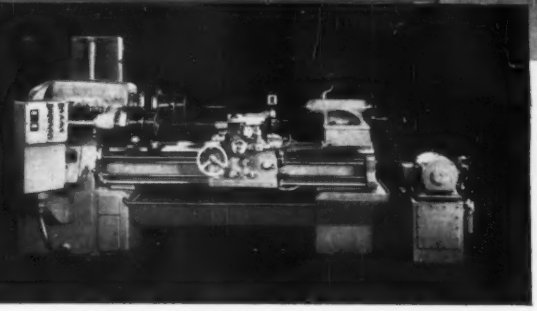
Circle Item 598 on postcard, page 199

(This section continued on page 178)

Don't Tool Up for Tomorrow's Boom with Yesterday's Lathes

MONARCH'S SPECIAL-PURPOSE LATHES OF TOMORROW...





1..The New Rotary Profile Tracer Lathe for Non-Circular Cross-Section Work

Up to *three times* more productive than equipment now in common use! Hand finishing drastically reduced! This new Monarch says "Lower Costs" two ways—on circular or non-circular cross-section work, such as the bottle molds above.

It has speed and accuracy that's only been a dream till now. Featuring the new Monarch supersensitive electro-hydraulic tracer, it delivers accuracy of duplication of ±.001" when the tool is traveling at a 100" per minute rate. At only a slight increase of error, tool travel up to 300" per minute is possible.

Stylus deflection pressure is a low 1½ ounces. Electrical amplification of its movement instantly translates work contour change into hydraulic slide movement.

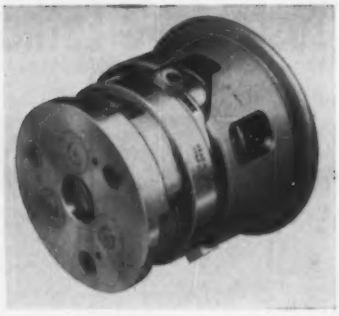
As you see, the master spindle is mounted at the front of the machine for ease of setup and operation. There's a positive gear drive from the headstock spindle through a quadrant-mounted idler which may be adjusted to eliminate any backlash between the lathe spindle and the master.

Want your costs to plunge downward? If that isn't worth a letter of inquiry—what is? *The Monarch Machine Tool Company*, Sidney, Ohio.

Monarch
TURNING MACHINES

IF IT CAN BE TURNED, THERE'S A MONARCH TO DO IT BETTER AND FASTER

For more data, circle this page number on inquiry card



Revolving type thread-rolling head announced by Landis Machine Co.

Landis Revolving Type Thread-Rolling Head

A revolving type thread-rolling head has been developed by the Landis Machine Co., Waynesboro, Pa., for exclusive application to its automatic forming and threading machine and four-spindle semi-automatic threading equipment. Designated the No. 7TRP (thread-rolling pull-off), this head has a 7/16- to 7/8-inch U.N.F. and U.N.C. thread range.

Normally, both the Landis automatic forming and threading and four-spindle machines are supplied with thread-cutting dieheads. The thread-rolling head has been designed with the same attaching requirements and can be easily interchanged with the thread-cutting heads. The new head is applicable to both sizes (3/4 and 1 inch) of these machines.

Of pull-off design, the No. 7TRP is automatically opened by interrupting the forward travel of the threading spindle. For closing, a cam-shoe actuates the head's operating ring as the machine spindle is withdrawn after rolling. Sufficient overtravel has been incorporated in the closing mechanism to guard against malfunction and also to minimize wear.

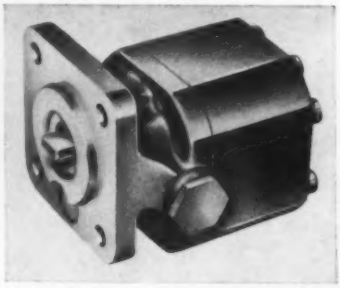
The outstanding feature of the new head is the replaceable helix angle bushings. One set of bushings functions as a "mean" helix angle for the entire U.N.F. and U.N.C. pitches and diameters within the range of the machine. When the exact helix angle is required for precision threads, the proper bushings can be supplied, thus eliminating the necessity of purchasing a special head to obtain precision threads.

The precision ground thread rolls can be reversed and both sides used. They are mounted on roller bearings retained in a cage to prevent their loss during change-over.

Circle Item 599 on postcard, page 199

Piston Pump with Built-In Charging Gear Pump

A versatile, rugged, extremely compact, lightweight, and low-cost piston pump with a built-in charging gear pump has been developed by the John S. Barnes Corporation, Rockford, Ill. The



Piston pump with built-in charging gear pump developed by the John S. Barnes Corporation

built-in charging gear pump has a capacity of 1/2 gallon per minute at 1800 rpm, which is ample for charging. The pump is now being made in various piston diameters that provide capacities of from 10 to 50 cubic inches per minute at pressures up to 4000 pounds per square inch. It can be mounted in any position. A direct, belt, or gear drive can be used.

Applications include small-volume, low-pressure; small-volume, high-pressure; and dual-volume, dual-pressure. The pump can also be assembled from mass-produced precision components to suit specific applications. It measures 3 1/2 by 3 3/4 by 3 1/2 inches, and weighs 5 to 6 pounds. Reservoirs, if required, are available in standard 1-quart to 3-gallon sizes. Tanks of special size can also be furnished.

Circle Item 600 on postcard, page 199

"Drednaut" Full-Face Goggle Respirator

A full-face combination goggle and respirator has been announced by the American Optical Co., Safety Products Division, Southbridge, Mass. This "Drednaut" model features a one-piece, mask-like, goggle-respirator combination molded from flexible rubber. An internally molded ridge separates the goggle section from the respirator section. A double facial seal results which stops exhaled air from reaching the goggle section. This feature is particularly advantageous when working in highly toxic areas. The goggle contains an impact-resistant acetate lens 0.060 inch thick.

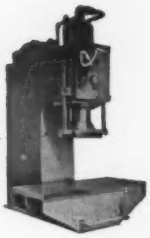
The goggle mask conforms to the contours of the face. In one model series, goggle ventilation is provided for by sixteen grommet type openings. These openings are covered with a fine, stainless-steel mesh screening which is designed to shunt liquids and dusts from the eye area. A gas-tight model series is also available without ventilation ports.

Thirteen sets of cartridges and filters are available for protection against dusts, mists, fumes, gases, sprays, vapors, insecticides, radioactive particulate matter or combinations of these hazards. The unit can be changed into any one of thirteen respirators simply by changing cartridges.

Circle Item 601 on postcard, page 199

(This section continued on page 180)

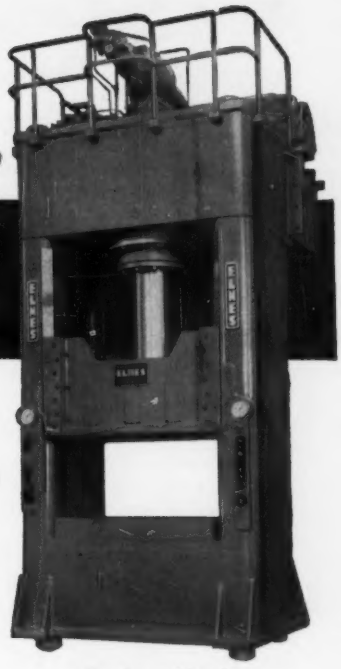
"Drednaut" goggle respirator



C-FRAME PRESS — for general purpose straightening, bending forcing, forming. Fast, flexible.

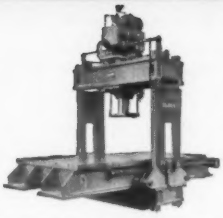
Elmes...

will "Job-Fit" hydraulic press equipment

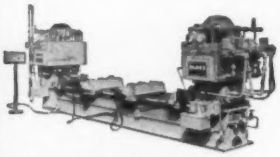


Drawing and Forming

to meet *your* requirements... exactly



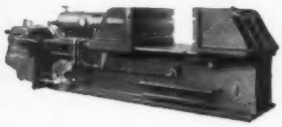
TRAVELING HEAD STRAIGHTENING PRESS — custom-built to meet special requirements.



TUBE REDUCING PRESS—another unit custom-designed for a specialized type of production.

HOBBING PRESS — a powerful tool for sinking hardened hobs into blanks of cold steel.

BULLDOZER—for heavy bending and forming. Optional choice of bed size, stroke, and speed.



Whether you're seeking improved and more economical press performance for your present metalworking production, or there's a development planning job to be done, you can count on Elmes to provide *the right press for the job.* Elmes builds a complete line of standard hydraulic presses for a broad range of metalworking operations—for drawing and forming, coining, forging, hobbing, bending, straightening, forcing, powder metal compacting, etc.

One of these standard Elmes® designs, "as is" or with simple modifications, may fit your needs exactly. Or, your requirements may be so special as to call for development of a "custom-built" press—a type of press designing and building which has long been an important part of Elmes service to industry.

Whatever your "pressing problem", *it will pay you to call in Elmes.* It just makes sense to take advantage of engineering knowledge, skill, and foresight *backed by more than 60 years of leadership in specialized hydraulic service.*

See your Elmes distributor, or write us direct. Recommendations and cost estimates will be supplied promptly.

Also a complete line of COMPRESSION and TRANSFER PRESSES for PLASTICS and RUBBER MOLDING

Elmes American Steel Foundries
ENGINEERING DIVISION

1162 Tennessee Avenue, Cincinnati 29, Ohio

METAL-WORKING PRESSES • PLASTICS MOLDING PRESSES • PUMPS • ACCUMULATORS

For more data, circle this page number on inquiry card

Wrenches of improved design made by J. H. Williams & Co.

Steel drawer announced by Republic Steel Corporation

Williams Wrenches of Improved Design

J. H. Williams & Co., Buffalo, N. Y., is now making a line of open-end, combination box-open end, and 15- and 45-degree offset box wrenches of improved design. Among the many refinements incorporated in this line are slimmer, more comfortable handles; smoother contours; and strong, thin heads that allow maximum clearance in close quarters. The new design has imparted a "balanced feel" throughout all sizes in the four styles of wrenches offered.

Circle Item 602 on postcard, page 199

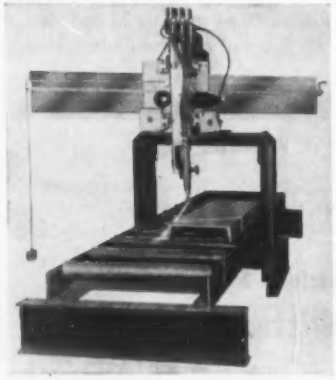
Cutter Designed for Metal Structural Shapes

The Steffan Mfg. Corporation, Salem, Ohio, has announced a structural shape cutter that employs many engineering features developed to reduce handling, layout, and working time in cutting I-beams, H-beams, angles, channels, bars, and plates. Two independently operated variable-speed motors activate the horizontal and vertical geared tracks to insure a smooth, steady cut.

Constant heat is achieved by solenoid valves which coordinate the flow of gas and oxygen at the burning tip. The cost of removing burning slag is reduced to a minimum by combining uniform speed and heat. A conveniently located adjustable dial can be set to obtain smooth mitered or straight cuts.

Handling of structural shapes is easily accomplished by means of a roller conveyor. The shape is rolled forward to the prescribed cutting position and locked in place by magnets. The cutters are available in 24-, 36-, and 48-inch stock-cutting sizes.

Circle Item 603 on postcard, page 199



Steffan cutter for metal structural shapes

Steel Industrial Drawers with Finger-Tip Handles

A line of steel industrial drawers that feature finger-tip handles for easy access is announced by Republic Steel Corporation's Berger Division, Canton, Ohio. The new handle is formed by a steel lip that runs the width of each drawer face. One of the new drawers has been designed to hold special nuts, bolts, and other small automotive parts that do not lend themselves to storage in open bins. Drawers are made also for all of the company's 12-, 18-, and 24-drawer insert cabinets.

Each unit is of three-piece construction, bonderized, and available in olive or gray baked-on enamel. The drawers, made in a wide variety of sizes and shapes, have sides slotted at 1-inch intervals and may be partitioned with slip-in metal dividers.

Circle Item 604 on postcard, page 199

Wagner Gearmotor and Speed-Reduction Units

The Wagner Electric Corporation, St. Louis, Mo., is offering enclosed gear drives to meet the majority of application require-

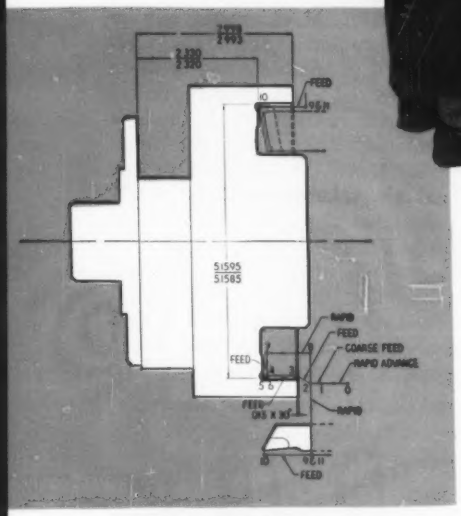
Wagner gearmotor speed reduction unit

ments for speed-reduction units of 125 hp and smaller, with output speeds ranging from 780 down to 1.2 rpm at 1750 rpm input speed. These drives are rated in accordance with all applicable standards of the American Gear Manufacturers Association.

Helical gears, heat-treated after cutting by a special process to obtain maximum hardness, give high capacity, great shock resistance, and extra wear life. Unit type housings of corrosion-resistant cast iron have the output shaft endplate and the mounting feet

(Continued on page 182)

The Olofsson Standard Cam Operated Precision Contouring Machine, Model, 42



A TYPICAL APPLICATION
The part: transmission rear brake drum.
Material: pearlitic malleable iron.
Operations Performed: boring, facing, chamfering and undercutting.
Rate of Production: 70 pieces per hour.

FOR FAST, FLEXIBLE COMBINATIONS OF PRECISION BORING, TURNING AND FACING

... the New OLOFSSON Standard Cam Operated Precision Contouring Machine Model 42

DIRECT CAM ACTION for mechanical control of precision tolerances gives the Olofsson Contouring Machine fast and accurate control over a wide variety of contouring operations.

Cams are easy to change. For more dependable operation they're mounted on a heavy duty spindle in the machine base.

All motors and hydraulic controls are located outside the base. The heavy duty cross slide provides a substantial base for fixture tooling.

DESIGN FEATURES

- **Direct Cam Action**
- **Low height to width ratio of spindles to ways.**
- **Automatically lubricated, hardened and ground V and flat ways.**
- **Both table slides, controlled by cams mounted on a single drive shaft.**

Get all the facts and specifications on the Model 42. Write for bulletin today.

THE OLOFSSON CORPORATION

2729 LYONS AVENUE, LANSING, MICHIGAN • PHONE: IVanhoe 4-5381

Manufacturers of Special Machinery and Precision Boring Machinery.

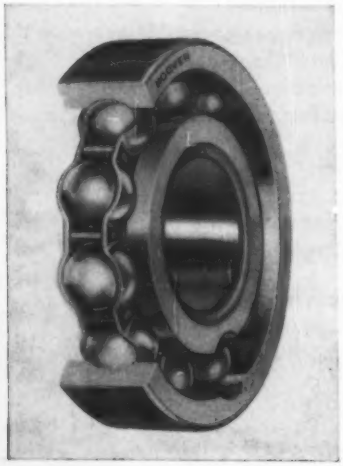
or flange cast as integral parts for strength and rigidity.

Foot-mounted, flange-mounted, and extended flange straight-line units are available as integral type gearmotors, with the motor and speed reducer forming an integral assembly; as all-motor type gearmotors, with a standard motor coupled to the input shaft of the speed reducer; and as separate speed reducer units. The latter can also be furnished for right-angle drive. Space-saving shaft-mounted reducers, for mounting directly on the shaft for the driven equipment, are also available in ratings through 40 hp.

Circle Item 605 on postcard, page 199

Hoover Ball Bearing

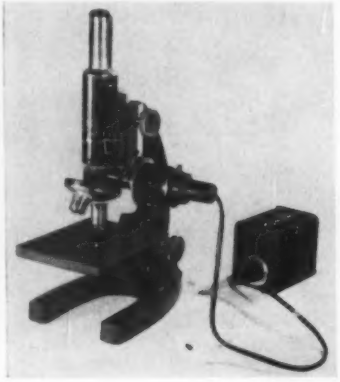
"Super Max" ball bearing designed for heavy radial loads made by Hoover Ball & Bearing Co., Ann Arbor, Mich. This bearing is now available for applications demanding sustained performance under especially heavy radial loads. It utilizes the maximum number of large-size balls that can be safely inserted in the bearing by way of an accurately placed filling slot. The design of the slot is such that the bearing will also carry combined radial and thrust loads where some thrust load-carrying ability is essential. Unusually high radial-load capacity is further achieved by quality-made components, which include extra-smooth "Hoover Honed" raceways and perfectly matched sets of "Micro-Velvet" balls. Made in light, medium, and heavy series, and available open or with single or double shields. Open- and single-shield models are also offered with a mounting snap ring.



Circle Item 606 on postcard, page 199

Bausch & Lomb Microscope

One of a line of low-cost metallurgical microscopes for routine applications in industry and schools. They have been designed to provide quick, accurate examinations of metal specimens and other opaque objects with the same high-quality results obtained with more expensive instruments. They are

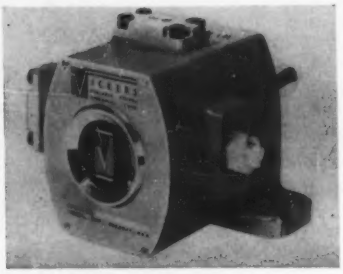


easy to operate and have been designed for the maximum in user comfort. The fine adjustment knob is located only a short distance above the table top, allowing the arm to rest in a natural position and making the slightest change in focus a routine matter. Instruments feature full-sized control knobs which are easy to grasp for all adjustments. All objectives are parfocal and centered in a revolving nose-piece which adjusts automatically for wear. They are easily portable for on-the-spot examination and analysis.

Circle Item 607 on postcard, page 199

Vickers Variable-Volume Hydraulic Pump

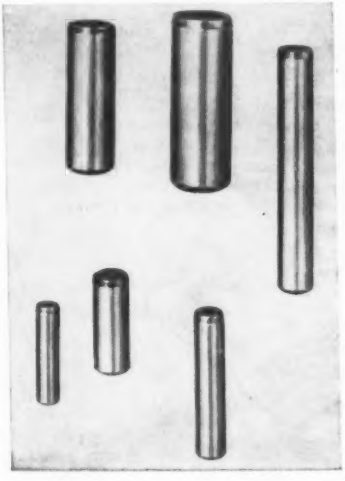
Variable-volume vane pump of 5-gallon-per-minute capacity announced by Vickers Incorporated, Detroit, Mich., a division of Sperry Rand Corporation. This pump automatically limits its delivery to system demand. An integral pressure compensator restricts the pump volume to pre-selected adjustable pressures. The pump is especially adapted for use as a fluid-power source for varying-volume-demand circuits. The nominal 5-gallon-per-minute rating is at 1800 rpm. Operating pressures range up to 1000 psi. Flange, foot, or gasket mounted models are available.

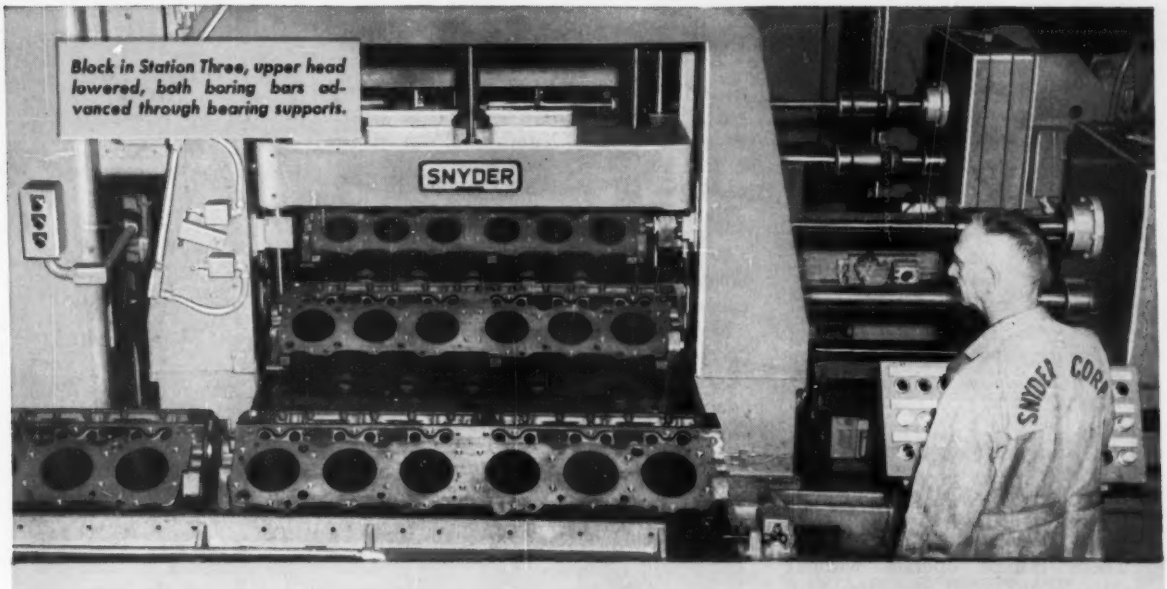


Circle Item 608 on postcard, page 199

"Blue Devil" Dowel Pins

Dowel pins for the machine tool and die industry brought out by the Safety Socket Screw Co., Chicago, Ill. A complete line of these heat-treated, alloy-steel dowel pins, in sizes from 1/8 to 1 inch, is available. They carry the same "Blue Devil" brand name as the maker's socket-screws. The dowel pins have a surface hardness of 60-64 Rockwell, with a finish of 8 micro-inches to assure accurate positioning to close tolerances. Standard pins are ground 0.0002 inch over listed diameter for a press-fit between mating parts,

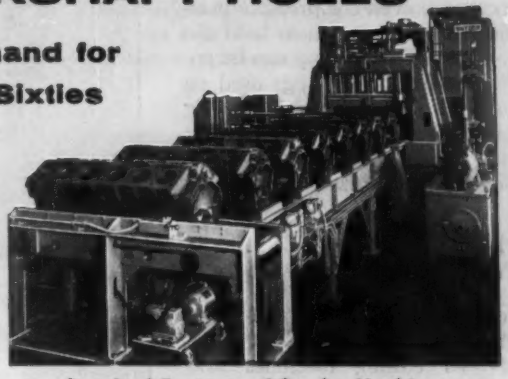




Block in Station Three, upper head lowered, both boring bars advanced through bearing supports.

PRECISION BORING OF 42″ LENGTH CAM AND CRANKSHAFT HOLES

SNYDERIZING Meets the Demand for Quality Parts for the Soaring Sixties



This 12-cylinder block is for heavy duty truck and marine engines aimed at taking a bigger bite of this booming market. Our Snyder special 7-station machine is helping this manufacturer SNYDERIZE for the Soaring Sixties by providing boring tolerances which make his product outstanding.

In regular production at a rate of 31 pieces per hour, main and camshaft bearing holes are rough and semi-finish bored simultaneously with all diameters held to manufacturers' specifications for alignment, roundness and concentricity. The distributor hole is also semi-finish bored in this machine to establish proper location to cam and crank bores.

Advanced engineering, both in product and production machines, is the best possible preparation for the competition of the next decade. We'll be happy to show you, too, how to SNYDERIZE for the Soaring Sixties to gain more efficient parts handling, gaging, assembly and machining. Write or phone for new brochure on machines for profit improvement.

Standard Features of Snyder Machines

1. SNYDER UNITS equipped with hardened and ground steel ways.
2. Building block principle throughout.
3. Automatic lubrication.
4. Walking beam transfer bar.
5. J.I.C. Standards throughout.
6. Electrical interlocks and full depth circuit throughout.
7. Panels equipped with SNYDER CIRCUIT SLEUTH.

SNYDER CORPORATION

(Formerly Snyder Tool & Engineering Company)

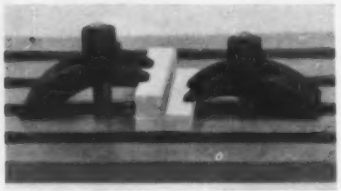
3400 E. LAFAYETTE—DETROIT 7, MICHIGAN

Phone: LO 7-0123

For more data, circle this page number on inquiry card

with "oversize" pins ground 0.001 inch over listed diameters for repair work. The diameters are held to tolerances of plus or minus 0.0001 inch.

Circle Item 609 on postcard, page 199



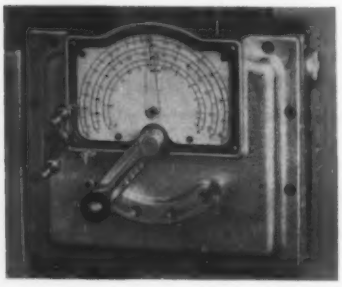
Hold-Down Clamps

"Insta-Clamps" that are fast and simple to operate, brought out by Insta-Clamp Co., Dearborn, Mich. These clamps operate without shims to their full capacities, saving time and the need for vises on many jobs. They will not clutter work areas or tip over when clamping onto narrow grooves, ledges, or corners; even one prong in position is strong enough to hold the work-piece. This clamp can be applied to fixtures and jigs used on universal and vertical mills, jig borers, punch presses, planers, and drill presses.

Circle Item 610 on postcard, page 199

Metering Unit for Wink Cutters and Metoveyors

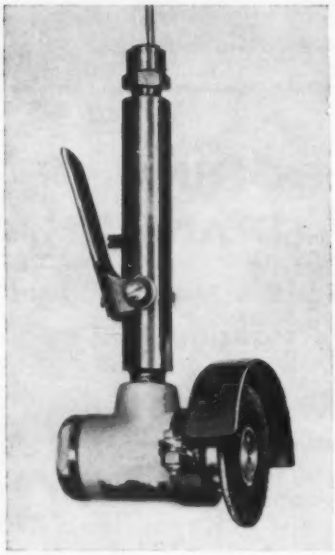
Metering unit to control cutting length on its Model M420 Wink universal cutting machines and M400 Metoveyors introduced by the Motch & Merryweather Machinery Co., Cleveland, Ohio. This device features a large, easily read dial graduated in feet and inches. A separate scale for each of three length ranges is provided. Length selection is quickly and precisely made by means of the sturdy hand crank at the left side of the front cover. Backlash is automatically compensated for, and length changes may be made while the machine is in operation or idle. Standard cutting length is from 1/2 inch to 60 feet.



Circle Item 611 on postcard, page 199

Cleco Angle Grinder

Small and rugged, gearless, high-speed 12V-180 angle grinder which heads line developed by Cleco Air Tools, Houston, Texas. High-speed cutting efficiency and adaptability characterize this machine. The air tool is said to maintain its speed of 18,000 rpm extremely well under load and to operate with a minimum of vibration. It is used with a specially designed depressed-center cutoff wheel. Also, it can be used as a sander. Cleco 14 GEQ-140A belt grinder of the new line has an abrasive belt with a resilient spiral-tooth rubber wheel, for smooth contact on the work. It cuts fast, is easily controlled, and imparts the best quality finish. Cleco 14 Series belt grinders are available in several models, with choice of thumb, lever, or "Quick-as-Wink" throttle. Belt-grinder attachments are available for 400 Series Cleco grinders. Line of Cleco grinders also includes the No. 11 with swivel inlet, or straight inlet, complete or with collect chuck and wheel guard.



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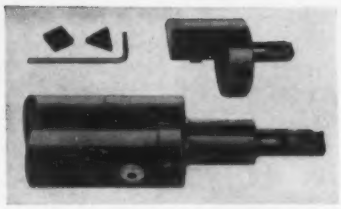


Wesson Boring-Bar with Interchangeable Heads

Adjustable boring-bar designed to finish small-diameter holes with throw-away inserts, developed by the Wesson Co., Ferndale, Mich. This micro-adjustable boring-bar can carry interchangeable heads for boring holes from 1/2 to 1 1/2 inches in diameter. Each head can be adjusted to cut up to a 1/2-inch larger diameter so that it is possible to cover the complete range with four heads. Also, each head can be adjusted slightly undersize so that holes less than the nominal size can be bored. Because length-to-diameter ratios of boring-bars are critical, these bars will be stocked partially finished. Heads will be finished to required lengths (limits depend on hole diameter) for specific applications. Interchangeable heads can be furnished for either triangular or square carbide throw-away inserts.

Circle Item 613 on postcard, page 199

Heavy-Duty Impactool

Size 5U-HD 1/2-inch drive, heavy-duty electric Impactool announced by Ingersoll-Rand, New York City. This tool is designed to deliver 25 per cent more power than the standard-duty 1/2-inch drive tools. It has an extra-strong hammer-case nose built for long life. A rubber nose cap effectively keeps dirt out and prevents scuffing. A new sturdy socket-retaining pin in the square driver is through-hardened

SHORT-CUT TO PRODUCTION!

ONE STEP INTO THE FUTURE ELIMINATES THESE COSTLY STEPS OF THE PAST

CAM ENGINEER

LAYOUT

INSPECTION

MODEL SHOP

Numeri-Trol slashes lead time from months to days, cuts changeover time from weeks to hours; here's how:

Typical fuel control cam production process is simplified to (1) preparation of machine control tape *directly from engine designer's performance curve*, and (2) inserting the tape into Numeri-Trol's control cabinet for *fully automatic production!*

NUMERI-TROL

59-29

Tape-Controlled Cam Milling Machines by Ex-Cell-O

Designed to Save Time!

- Drastically cut lead time, eliminate tooling costs, reduce machining time of cams for aircraft or missile fuel systems, small turbine blades and other complex prototypes and production parts.
- Precision-built especially for use with high performance pulse data inputs.
- Rugged construction with anti-friction table and cross-slide bearings, and servo-actuated hydraulic drive motors.
- Lateral movement of work head, transverse cross-slide and 360° work indexing are fully tape-controlled.
- Simple control and automatic functions eliminate human error.
- No need for blueprints or models. Numeri-Trol permits maximum security for advanced projects.

Have a tough part that's costly to produce? Write direct or ask your Ex-Cell-O Representative how Numeri-Trol Cam Milling Machines and Precision Profiling Machines can save you time and money.

EX-CELL-O FOR PRECISION XLO

EX-CELL-O CORPORATION *Machinery Division*
DETROIT 32, MICHIGAN

EX-CELL-O PRECISION PRODUCTS INCLUDE: MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • TORQUE ACTUATORS • THREAD AND GROOVE GAGES • GRANITE SURFACE PLATES • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

For more data, circle this page number on inquiry card

for long life. The dirt-resistant, heavy-duty switch is totally enclosed for trouble-free service. This Impactool is 10 1/4 inches in length and weighs only 6 pounds 4 ounces. The side-to-center distance is 1 7/16 inches. Although designed primarily for nut running, this tool, with standard attachments which can be easily and quickly applied, will drill, drive screws, ream and tap, as well as do wire brushing and hole sawing.

Circle Item 614 on postcard, page 199

Table for Checking Hole Locations

Inspection table for checking location of holes in templates, jigs, fixtures, and other flat sheet-metal work developed by the Wiedemann Machine Co., King of Prussia, Pa. Hole center-line distances (X and Y coordinates) from two edges of the sheet are read optically directly from decimally graduated scales. These dimentions may be read in 0.0005-inch increments at the rate of one to three holes per minute, a fraction of the time required by conventional methods. This low-cost mechanical method is fast, positive, accurate and does not depend on highly skilled operators. Material up to 36 by 42 inches may be inspected without angle plates, verniers, height gages, indicators, and other such equipment ordinarily used for precision inspection. Likewise, no compensating figures or other calculations are necessary. The work is secured to the table top against locating edges, using quick-acting clamps. The carriage with the optical scanners and X and Y scales travels freely over the table. The operator inserts the stylus into each hole to be inspected, and reads the center-line dimensions from the edges of the sheet. The scales are graduated to 0.050 inch, and the scanner is used to read the hole location to 0.0005 inch.

Circle Item 615 on postcard, page 199

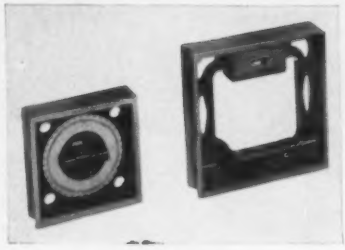
Oxweld Gas Regulators

One of a unique line of industrial gas regulators without gages introduced by the Linde Company, division of Union Carbide Corporation, New York City. In addition to lower initial cost, the new Oxweld regulators eliminate gage breakage and replacement. Designed for use with oxygen, acetylene, or propane on cylinders or manifolds, the regulators provide the same safe, dependable, and accurate performance found in conventional Oxweld regulators. Known as the R-550 (oxygen), the R-551 (acetylene), and the R-552 (propane), the large-capacity, single-stage regulators have stem type valves and are designed with an absolute minimum of exposed parts to reduce maintenance costs and assure long life. They are said to be extremely valuable on jobs where regulators are subject to rough handling or are switched from cylinder to cylinder frequently.

Circle Item 616 on postcard, page 199

Wyler Leveling Squares

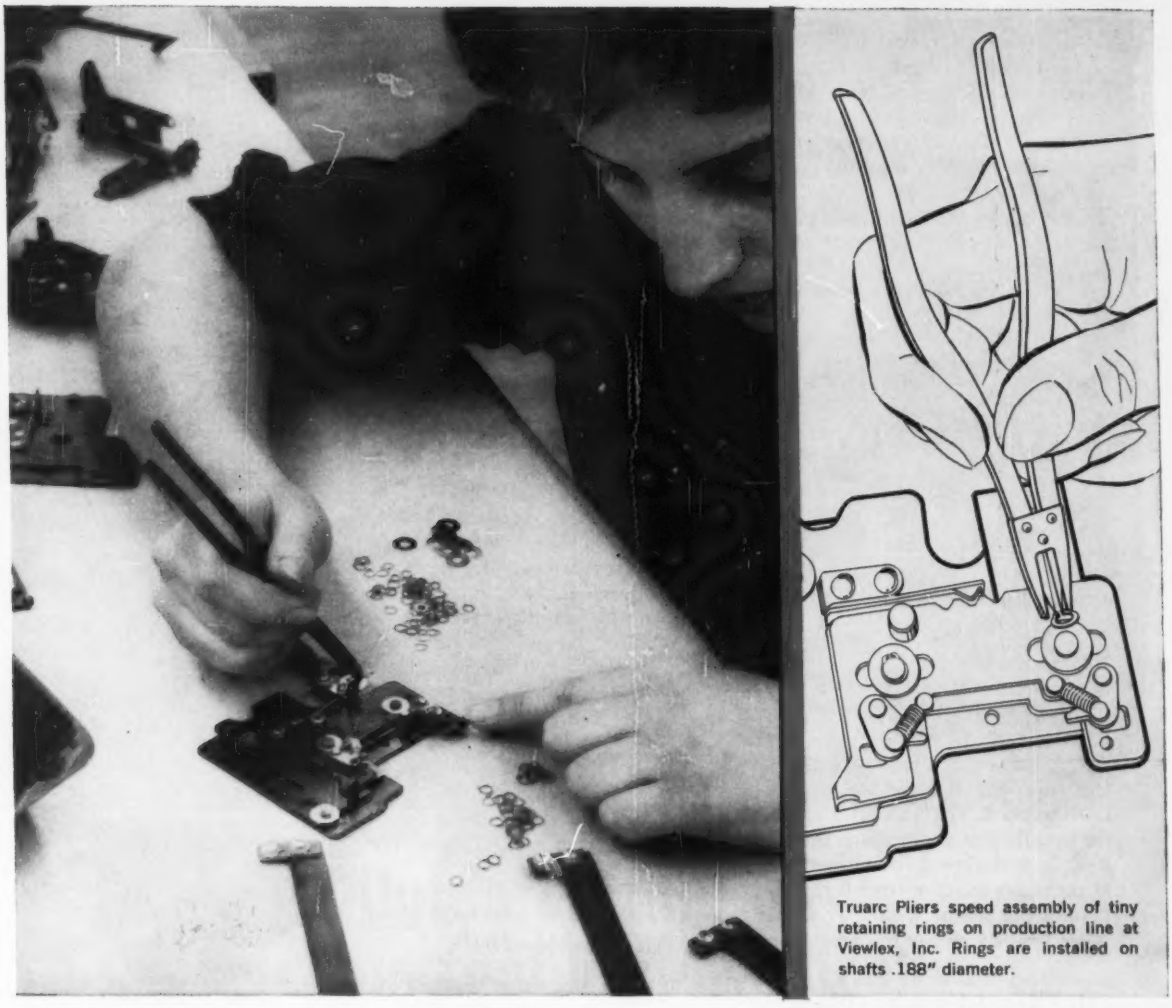
Two new types of leveling squares of Swiss precision make introduced by Opto-Metric Tools, Inc., New York City. The solid square, which is recommended for checking squareness between machine members, is available in three degrees of sensitivity: 3, 5, and 10 seconds of arc to meet any reasonable requirement. Due to its extreme accuracy, the range is limited to that of the bubble tube, namely, plus or minus seven intervals. The other square, which is really a simplified and inexpensive clinometer, has a range of 0 to 180 to 0 degree with vernier reading in 6 minutes of arc. The inherent accuracy is 30 seconds of arc.



Circle Item 617 on postcard, page 199

"Hydroway" Hydraulic Dynamometer

"Hydroway" dynamometer of portable, compact, and rugged design built by Hydroway Scales, Inc., Royal Oak, Mich. The over-all length of this dynamometer is 13 inches. The weight is only 15 pounds. The capacity range is from 0 to 5000 pounds, with a built-in 5 to 1 high safety factor. Maximum movement of the piston,



Truarc Pliers speed assembly of tiny retaining rings on production line at Viewlex, Inc. Rings are installed on shafts .188" diameter.

Truarc rings eliminate rejects, cut assembly time 40%

Production engineers at Viewlex, Inc., Long Island City, N.Y., save time, speed work with Waldes Truarc retaining rings.

On Viewlex Instruct-O-Matic automatic slide projector, the top plate assembly utilizes five Truarc Series 5100-18 external rings to secure the lost motion plate to the base.

Operator above uses Truarc Standard Plier No. 0018 for installation and removal of rings in accurately located grooves, pre-cut before the assembly is made. Precision engineered plier tips grasp tiny rings securely to speed assembly and disassembly. Pliers are pre-set to avoid over-spreading the rings.

The original design of the unit called for shoulder rivets. In addition to requiring a longer stud, the rivets were difficult to control for height consistency. As a result, when the rivets were flattened, binding or looseness between the plates often caused expensive rejects. For maintenance of the unit, it was necessary to scrap the entire assembly.

Use of Truarc rings assures precise seating of the plates and eliminates rejects caused by faulty riveting. Result: an assembly time saving of 40% at Viewlex. Use of Truarc rings may achieve similar or greater savings—in labor, machining or parts—on your production lines. These versatile fasteners come in 50 functionally different types, as many as 97 sizes within a type, 6 metals, 13 finishes.

They replace nuts and bolts, machined shoulders, threaded collars and set screws, bowed washers or springs and cotter pins, and other fasteners and fastening operations. (A wide line of semi-automatic and manual Truarc tools are available to speed ring assembly). For facts on the entire line of rings, tools and application ideas, write for the new Waldes Truarc catalogs: RR 10-58 and AT 10-58. Waldes Kohinoor, Inc., 47-16 Austel Place, Long Island City 1, N.Y. 9.16

WALDES
TRUARC®
RETAINING RINGS
Waldes Kohinoor, Inc., Long Island City 1, N.Y.

TRUARC RETAINING RINGS . . . THE ENGINEERED FASTENING METHOD FOR REDUCING MATERIAL, MACHINING AND ASSEMBLY COSTS

©1959 WALDES KOHINOOR, INC.

under full load, is only 0.032 inch. A dial face 6 inches in diameter with jet-black figures on a white background facilitates load reading. A pre-set pointer (as shown in the illustration) is available at a slight extra cost. This pointer can be set to the safe load position to serve as a guide to prevent overloading.

Circle Item 618 on postcard, page 199

Ross Speed-Control Valve

Low-cost, lightweight speed-control valve called the "Cub," brought out by Ross Operating Valve Co., Detroit, Mich. Available in 1/8- and 1/4-inch pipe sizes with metering adjustment which permits five full turns from closed to full open position. This valve is adapted for installation where space is limited. It is designed for air service at pressures ranging from 0 to 150 pounds per square inch.

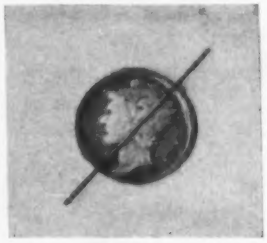
Circle Item 619 on postcard, page 199

DeVlieg Adjustable-Blade Facing Tool

Adjustable-blade facing head for precision plunge-facing of wide surfaces announced by DeVlieg Microbore Division of DeVlieg Machine Co., Royal Oak, Mich.

This "Microface" tool is the latest addition to the DeVlieg Microbore tooling system. It eliminates the need for special tooling to bore, face, or spot-face wide surfaces. The solid one-piece head is designed to assure maximum rigidity and extend tool life. Interchangeable high-speed steel or carbide blades may be replaced right on the machine. The dovetail principle of mounting maintains consistently accurate positioning of the blade-holder throughout its range of adjustment so that the cutting edge of the blade remains square to the center line at all times. The tool is available in a range of sizes to machine diameters from 1 1/2- to 8 1/2-inch sizes. It is especially adapted for use in boring machines, turret lathes, and heavy drilling equipment.

Circle Item 620 on postcard, page 199



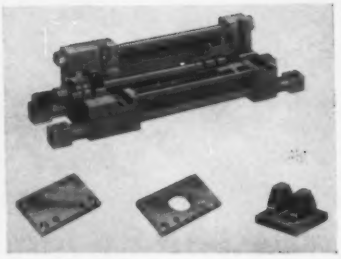
Tiny Carbide Drill

Tiny drill just four times the thickness of a human hair, five times smaller than a dentist's drill, and only twice as long as a dime is wide, brought out by Super Tool Co., Detroit, Mich., division of Van Norman Industries. This perfectly fluted, solid cemented-carbide drill has a diameter of 0.0135 inch. It can be used for precision drilling non-ferrous and abrasive materials—like copper, aluminum, and plastics in rocket and missile work, aircraft instruments, and printed circuits employed in the electronics field. Highly wear resistant, it will produce hundreds of holes without size variations.

Circle Item 621 on postcard, page 199

Square-End Double-Acting Air Cylinders

One of a line of square-end, double-acting air cylinders for holding, positioning, or moving work introduced by A. Schrader's



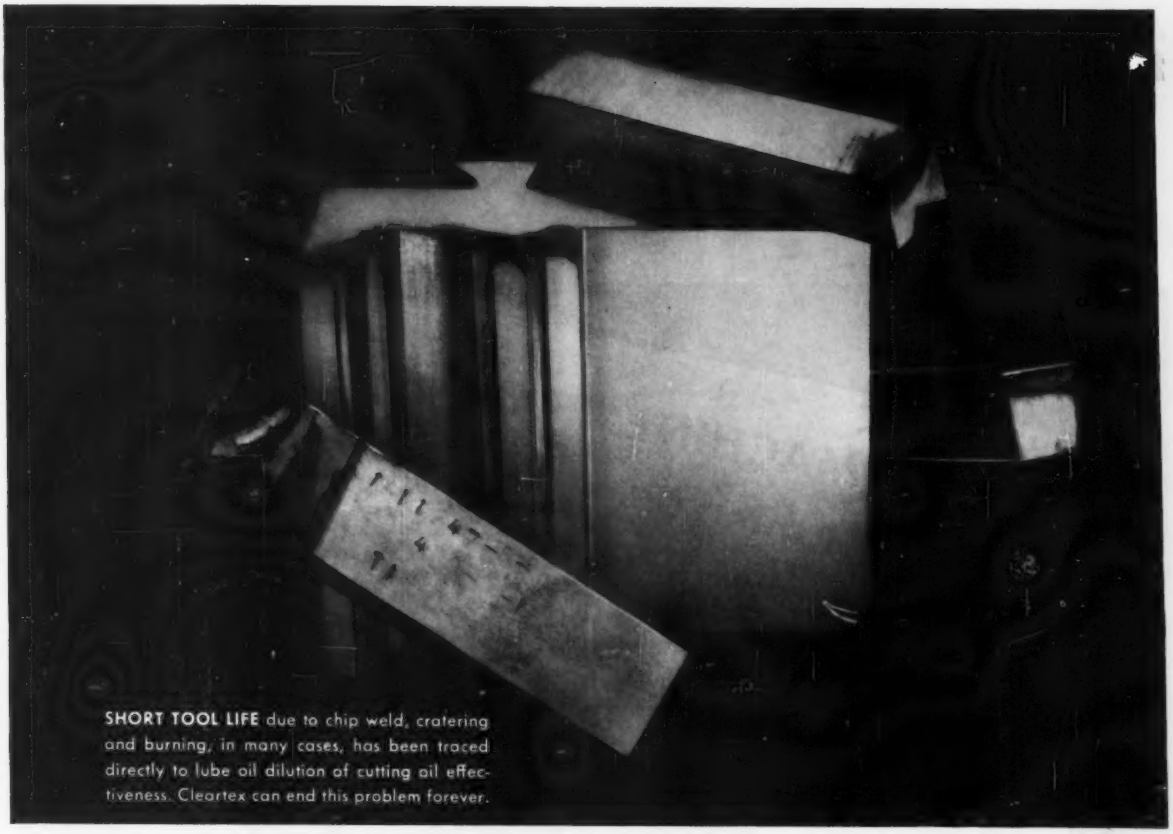
Son, Division of Scovill Mfg. Co., Brooklyn, N. Y. Available in five sizes up to a bore diameter of 4 inches, these cylinders are designed for air pressure up to 250 psi or hydraulic pressures up to 750 psi. Each size is obtainable with or without adjustable cushion. There are five available mountings: bolt, flush, leg, base, or side flush. New square-end design and interchangeable mounting plates permit mounting in either a parallel or 90-degree position relative to ports. All cylinders are made to meet and exceed JIC standards.

Circle Item 622 on postcard, page 199

Aluminum Chip Buggy

Improved-design, aluminum chip buggy, weighing only 180 pounds but capable of handling loads up to 1800 pounds, now being manufactured by the Rolling Mill Division, E. W. Bliss Co., Salem, Ohio. Weighing about 40 per cent less than similar steel buggies, it is designed to reduce handling fatigue, and provide corrosion resistance where needed. This buggy has commercial wheels in either plain steel rims or rubber-tired units and a swivel wheel and bracket for easy handling in small areas. Fabricated of 3/16-inch aluminum, the buggy is 44 1/2 inches high, 30 inches wide, with a volume capacity of 32,000 cubic inches.

Circle Item 623 on postcard, page 199



SHORT TOOL LIFE due to chip weld, cratering and burning, in many cases, has been traced directly to lube oil dilution of cutting oil effectiveness. Cleartex can end this problem forever.

Diluted cutting oil shortens tool life drastically

Lubricating oil is probably leaking into the cutting oil sumps of your automatic screw machines as you read this. Current research proves that this is happening in 70% of all the automatics in use today! And where it happens, it shortens tool life by as much as 50%—even 70%. On top of this, the cost of extra regrinds, lost production during tool changes, and excessive scrap production is putting a premium on screw machine operation in too many shops.

Look for these symptoms. One sure sign of dilution is the need for frequent refilling of the lube oil sump. If you are using an ordinary lube oil, this dilution will create two additional—and more costly—symptoms: excessive scrap production and frequent regrinds. Now you can eliminate these forever with the

TEXACO CLEARTEX CURE

The exceptional chemical stability and load-carrying ability of Texaco's Cleartex series make them equally suitable for use as cutting oils, lubricants or hydraulic fluids. All you have to do is use them for both cutting *and* lubrication. With Cleartex in *all* your sumps, you'll find cutting oil dilution will stop and screw machine production cost will drop substantially.

Write today for your copy of Texaco's helpful new booklet "Cleartex in Automatic Screw Machines"...and contact your local Texaco Lubrication Engineer for an authoritative survey of your automatics. Just call the nearest of the more than 2,000 Texaco Distributing Plants, or write Texaco Inc., 135 East 42nd Street, New York 17, N. Y. Dept. MA-22.

CONSTANT PROGRESS IN OIL'S FIRST CENTURY

LUBRICATION IS A MAJOR FACTOR IN COST CONTROL

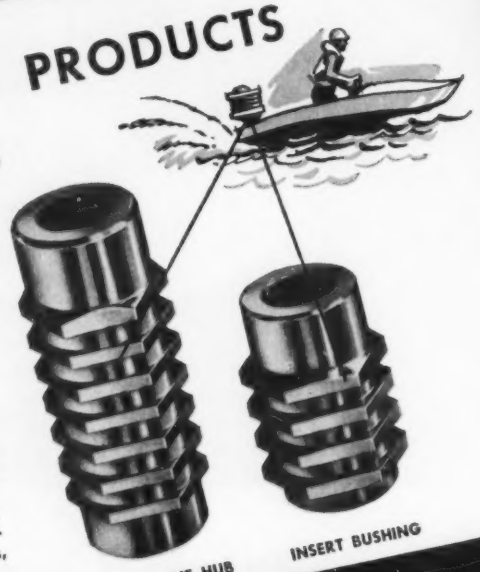
(PARTS, INVENTORY, PRODUCTION, DOWNTIME, MAINTENANCE)

two typical cases where MUELLER BRASS *determined the best and most*

CASE HISTORY 1750

SCREW MACHINE PRODUCTS for outboard motors

Mueller Brass Co. Methods Analysis Engineers, after careful consideration of every aspect of the job requirements, found that the best method of producing these 2 outboard motor parts at the lowest cost was as screw machine products made from hollow hex rod. The insert drive hub and insert bushing are used in the lower units of one of America's most powerful outboards and must absorb constant punishment without failing. Mueller Brass Co. has one of the world's largest automatic screw machine departments fabricating both ferrous and non-ferrous custom parts. Parts can be produced in an infinite variety of shapes and sizes from 1/8" to 3 1/4" in a wide range of free cutting and specialized alloys. Complete facilities are available for all secondary and finishing operations, as well.



INSERT DRIVE HUB

INSERT BUSHING

THE MAN FROM MUELLER BRASS CO.

can give you sound, unbiased advice on the one best method of making your parts because Mueller Brass Co. is the only fabricator in the country offering all these methods of production. An experienced "Methods Analysis Department" has at its command a complete knowledge of the advantages and limitations of each production process. This unique technical service is your assurance of getting the best product at the best price . . . made the one best way.

FORGINGS

PLASTIC INJECTION MOLDING

MUELLER BRASS CO.

CO. METHODS · ANALYSIS · SERVICE

economical method of producing parts

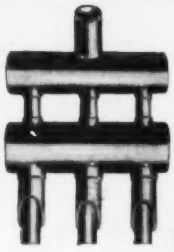
CASE HISTORY 226

COLD-PREST® IMPACT EXTRUSION for door closer cylinder

By producing this door closer cylinder as a Cold-Prest Impact Extrusion, several important advantages are realized: formerly made in three pieces, the part is now made as one piece in one operation which eliminates machining and assembly operations. The possibility of leakage is eliminated and the part has better physical properties, as well as a smooth, bright finish. Mueller Brass Co. has complete facilities for producing Cold-Prest impact extrusions of aluminum, copper, brass, bronze and steel. Square, rectangular and cylindrical shells up to 28" in length are possible depending on wall thickness and other design details. Parts can be designed having ribs, flutes, splines or bosses . . . with multiple wall diameters and with various wall sections.

POWDERED METAL PARTS

SAND CASTINGS



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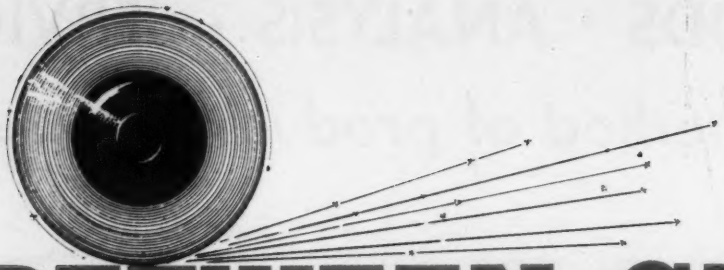


By E. S. Salichs

BETWEEN GRINDS

Pinch on Inch

The difference of 0.000002 inch between the standard United States inch and the Great Britain inch was abolished on July 1, which was designated "Inch Day" by the U.S. Bureau of Standards. In this give-and-take-a-particle-of-an-inch trade, the U.S. inch shrank by about half the difference mentioned and the G.B. inch expanded accordingly. Now what happens to the Perfect 36?

They Pressed to Success

An interesting article on the history of the Verson Allsteel Press Co., a business built by an industrious family, appeared in the *Chicago Daily Tribune*, on May 18 (written by William Clark, as part of a series on fine Chicago-area companies). The Versons, Russian-born father and two sons, arrived in Texas in 1910 with fifty cents in their pockets and without fifty English words in their combined vocabulary. By 1917, however, they had bought a small machine shop in Chicago, soon to be disposed of, as the brothers David and John contributed their efforts to World War I. After the war they purchased another machine shop, which was to become the Verson Allsteel Press Co. Family ownership has helped the company to come up with new machines and processes, according to the brothers and David's son, Melvin. If they want to do something, they sit right down and have a directors' meeting and vote to do it; sometimes they do it and then have the meeting. Incidentally, the Versons have a $500,000 press in their plant which they use only for their own research.

Drums in the Deep

At the Nuclear Power Station in Santa Susana, Calif., radioactive wastes are placed in drums, incased in cement, and dropped into the sea, according to a paper on systems of handling radioactive by-products recently presented at a convention of the American Society of Civil Engineers. Fish swimming in the vicinity, having noted these strange cylindrical deposits, have been heard to remark on the far-reaching influence of a certain venerable American architect who died recently.

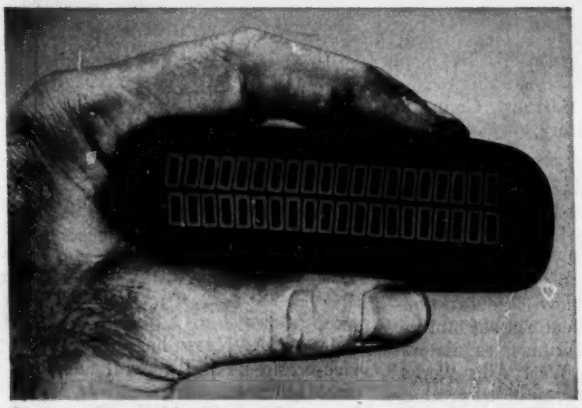
As the Cake Crumbles

Bakeries expect a certain proportion of "cripples"—as cakes are called that won't come out of the baking pans without breaking or crumbling. But when one bakery suffered a loss of $647 after baking a batch of 6000 angel food cakes, as the result of a brown scale on the aluminum pans, an Oakite technical sales representative was called in. According to *Oakite News Service*, he recommended a reconditioning procedure for the pans, thus reducing the loss by 92 per cent. But don't call that work of art your wife whips up a cripple just because it resembles topography.

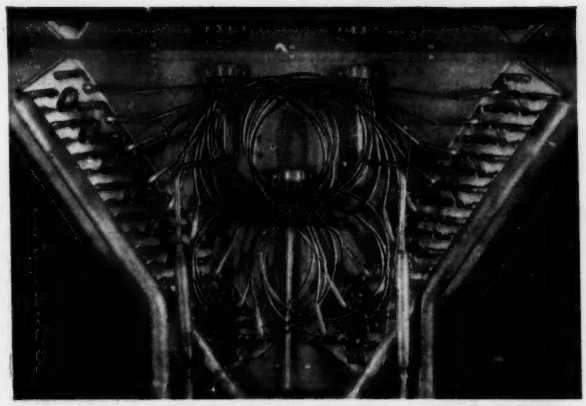
C. E. KOPP (right), factory manager of Evinrude Motors, Milwaukee, Wis., receiving a 1959 Honor Citation for "excellence in gear production and effective use of modern gear production equipment" from M. R. Anderson, president, Michigan Tool Co., Detroit, Mich., sponsor of the annual award. Evinrude, one of ten firms that received citations, was honored for its accomplishment in adapting "chipless machining" to the production of outboard motors (particularly on stainless-steel shafts), increasing shaft strength, and eliminating the waste of materials in the form of chips. Details of this company's method of cold-forming splines in hardened and ground, stainless-steel propeller shafts were presented in the article "Splines Formed Ten Times Faster by Cold-Rolling," published in the August, 1957, number of MACHINERY.

BETTER WAYS of doing things with seamless copper tube are unlimited—from capillary sizes to 26-inch diameter—round tubes or special shapes.

A better product faster. In the Kodak Roll Paper Dryer-Glazer shown below, photographic print paper travels around a heated, mirror-smooth, chromium-plated copper drum. This drum could be formed from sheet metal, welded and ground. But Eastman Kodak Company takes a production short cut and buys the drums ready made—Anaconda seamless copper tube 26" inside diameter, in wall thicknesses of ⅛", cut to 20" lengths. Having the thermal conductivity and corrosion resistance needed, the tube is also easy to polish to a high mirrorlike finish (photo, left), provides an excellent base for fine chromium plating. No seams mar the surface. Production time and steps are cut.



Rectangular copper tube carries current and coolant. By liquid cooling conductors in generator stator bars, General Electric has opened the way to doubling generator ratings without appreciably increasing frame size. Tubes, approximately 0.300" x 0.130" O. D., shown in cross section above, are shipped in long coils. Special-shape tubes are available in a wide variety of sizes, cross sections, and alloys.



High-precision tubes meter fluids. York Corp., subsidiary of Borg-Warner, has found restrictor-tube metering of refrigerant in packaged air-conditioning units up to 25-ton capacity has greatly reduced field service, made possible the 5-year protection plan on all units. Anaconda Copper Restrictor Tubes have consistently met York's strict requirements. These tubes are available in copper or aluminum in nominal I. D.'s from .025" to .090".

WHETHER you need long lengths of copper capillary tubing for air, hydraulic, or lubricating lines or for instrument tubing—or large-diameter tube in copper or a copper alloy, call your American Brass Company representative. He can help you select the product you need from the broadest range of seamless tubes available to industry. Or write: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.

5943

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SEAMLESS COPPER TUBE

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Made by The American Brass Company

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News OF THE INDUSTRY

California, Colorado, and Texas

O. S. WALKER CO., Worcester, Mass., has announced acquisition of the principal assets and all patent rights of the BUCK MFG. CO., San Jose, Calif. RICHARD F. CAREY, formerly sales manager for the Buck company, has been appointed general manager and secretary of the new corporation, which will operate under the same name and continue to do business from its present location.

FORD MOTOR CO., Dearborn, Mich., and AERONUTRONIC SYSTEMS, INC., Glendale, Calif., have announced their merger. To be known as AERONUTRONIC, a division of Ford Motor Co., it was previously a majority-owned subsidiary of Ford. GERALD J. LYNCH, formerly president of Aeronutronic, is now general manager of the new division.

JOHN R. RINKEVICH has been appointed sales representative of the Mueller Brass Co., Port Huron, Mich. Mr. Rinkevich has been assigned to the Denver, Colo., office.

HARRY M. BETTS has joined Dolan Industrial Sales, Houston, Tex. This company represents a number of leading machine tool builders.

Illinois and Wisconsin

SUNDSTRAND CORPORATION, Rockford, Ill., has added a precision abrasive belt grinder line to its Sundstrand machine tool operation. Addition of this new line resulted from the acquisition of the inventory of ENGELBERG INC., Syracuse, N.Y. Engelberg will continue to manufacture part of the line as a subcontractor. Sales will be handled through the Sundstrand Machine Tool sales office in Belvidere, Ill.

WILLIAM CONOVER has been promoted from field sales engineer to regional sales manager of Parker-Kalon, a division of General American Transportation Corporation, Clifton, N. J. He will make his headquarters in the company's Chicago office and will be directly responsible for field sales management in Illinois, Indiana, Missouri, Kansas, Iowa, Wisconsin, Minnesota, Nebraska, and North and South Dakota.

SPEEDWAY MFG. DIVISION of Thor Power Tool Co., LaGrange Park, Ill., has announced the appointment of JOHN R. BOSSENGA as assistant to the chief engineer, and the promotion of ERNIE C. RANGUS to production and tooling engineer and GEDIMINAS BUBELIS to chief draftsman, all in the engineering department.

CLEARING division of U. S. Industries, Inc., Chicago, Ill., has announced the appointment of GEORGE E. WIND to service staff engineer, and JOHN A. KOPINA to assistant service manager.

BESLY-WELLES CORPORATION of South Beloit, Ill., has completed a new grinding test laboratory. It will be used to study customer's grinding problems under simulated production conditions.

CHARLES H. TUTTLE, JR., has been appointed field representative for the Allen Mfg. Co., Hartford, Conn., in the Chicago territory.

ALLIS-CHALMERS MFG. CO., Milwaukee, Wis., has announced the promotion of WILLIAM C. KRECKLOW and GEORGE J. SLIES to general superintendents in the manufacturing department of the Industries Group. Mr. Krecklow is now responsible for all manufacturing of motors, generators, transformers, regulators, and rectifiers at West Allis works. Mr. Slies takes charge of all production of switchgear and electrical controls, with direct supervision of manufacturing in the Hawley shop.

As a result of Mr. Krecklow's new appointment, the following advancements have been made in the Industries Group production control department: ROBERT L. CARLSTEIN, from assistant production control manager to production control manager; MILTON W. SCHAEFER, from superintendent of production scheduling to assistant production control manager; JOHN E. BRINKMANN, from assistant superintendent of production scheduling to superintendent; and LLOYD G. WEHNER, from foreman of production scheduling to assistant superintendent.

Michigan

WHITMAN & BARNES DIVISION of the United-Greenfield Corporation has announced the retirement of E. S. ANDERSON. He served as assistant sales manager for the Whitman & Barnes Division at Plymouth, Mich., and also was assistant secretary of the parent organization. GEORGE H. MALONY was named to succeed Mr. Anderson.

James A. Neff, vice-president and general manager, Mechanical Air Controls, Inc.

JAMES A. NEFF has been made vice-president and general manager of Mechanical Air Controls, Inc., Detroit, Mich. Mr. Neff comes to his new post from the Neff Engineering Co. of Fort Wayne, Ind., where he had been in sales and engineering in the pneumatic and hydraulic fields.

DANA CORPORATION, Toledo, Ohio, has announced the acquisition of the Rzeppa constant-velocity universal-joint assets of the GEAR GRINDING MACHINE Co., Detroit, Mich. Rzeppa will be operated as a separate division of the Dana Corporation and will remain in its present facilities in Detroit.

R. C. MAHON CO., Detroit, Mich., has named R. J. MCINTOSH plant manager of the structural steel man-

For the savings in tool costs made by Hydroforming Col. Herman E. Lacy calls this his

DOLLAR AISLE

Col. H. E. Lacy is owner of Hydroforming Company of America, Inc., Chicago. As one of the nation's leading suppliers of custom Hydroformed parts, he is exceptionally well qualified to talk on tool cost savings. "The unique Hydroform technique," says Col. Lacy, "has saved our customers *millions of dollars of tool costs.* Further, Hydroforming combines extreme precision in deep drawing, with versatility that gives designers unequalled freedom. Better drawn parts, in fewer operations, at lower costs, can be yours by Hydroforming."

The photo above shows five Cincinnati Hydroform® machines in operation at this custom deep drawing shop—an 8″, a 12″, two 19″ and a 23″ size machine. The company's capacity for producing larger Hydroformed parts will soon be increased by the addition of a Cincinnati 32″ Hydroform.

To determine if Cincinnati Hydroform machines can produce savings for your manufacturing program, call in a Meta-Dynamics Division field engineer.

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META-DYNAMICS DIVISION
Machines for Metal Forming and Heat Treating
THE CINCINNATI MILLING MACHINE CO.
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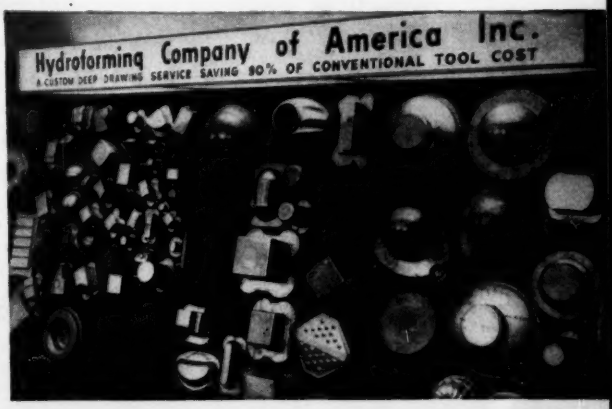
CINCINNATI



This photo of a display panel at Hydroforming Company of America, Inc., shows the wide range of Hydroformed part size, gage and complexity of shape produced by this firm.

XUM

ufacturing division, of which he is also superintendent. He succeeds GRAHAM DICK, who will continue to be affiliated with the division in an advisory capacity.

BARRY CONTROLS, INC., Watertown, Mass., has announced an agreement to acquire the WEST POINT MFG. CO., Detroit, Mich. The acquisition is to be made through VLIER ENGINEERING CORPORATION, a subsidiary of Barry Controls, and the business will be operated as the WESPO DIVISION of Vlier. The Vlier company maintains headquarters at Los Angeles, Calif.

FERKANY & SORENSEN ASSOCIATES of 2832 E. Grand Blvd., Detroit, Mich., has been appointed as sales representative in Detroit and surrounding counties for gaging products of the TAFT-PEIRCE MFG. CO., Woonsocket, R. I.

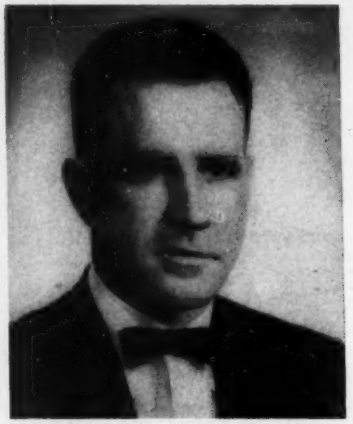
LAWRENCE A. MCDONALD, former sales manager of SUPER TOOL CO., cemented-carbide tool manufacturing division of Van Norman Industries, Detroit, Mich., has been elected vice-president of sales.

JOSEPH T. RYERSON & SON, INC., Detroit, Mich., has announced the addition of Reynolds aluminum to its stocks. EDWARD D. VERKERK has been appointed head of the aluminum sales department.

New England

PRATT & WHITNEY CO., INC., West Hartford, Conn., announces three executive changes. JACOB J. JAEGER has been elected president. Formerly executive vice-president, he succeeds EDWARD P. GILLANE who has been elevated to the position of assistant to the chairman of the board. Also, EDWARD J. SHAGES, vice-president in charge of manufacturing, has been elected to the board of directors.

Jacob J. Jaeger, president of the Pratt & Whitney Co., Inc.



Joseph C. Olson, vice-president—manufacturing, the Bullard Co.

JOSEPH C. OLSON has been elected vice-president—manufacturing of the BULLARD CO., Bridgeport, Conn. He has been factory manager since June 1, 1958.

ASSOCIATED SPRING CORPORATION, Bristol, Conn., has announced the following personnel changes. HARRY B. DAUPHINAIS becomes assistant to the corporate director of marketing. STANLEY M. RIMMER replaces Mr. Dauphinais as general manager of the corporation's Gibson Division. JOHN B. BECKWITH moves from engineering manager of the Bristol Divisions to succeed Mr. Rimmer as spring works manager. THEODORE M. ADGATE, assistant engineering manager of the Bristol Divisions, becomes engineering manager, succeeding Mr. Beckwith.

DANA H. HAYWARD has been elected assistant secretary of PRATT & WHITNEY CO., INC., West Hartford, Conn. He is also assistant secretary of Colt's Patent Fire Arms Mfg. Co. and Chandler-Evans Corporation, two other local subsidiaries of the FAIRBANK WHITNEY CORPORATION.

NORTON CO., Worcester, Mass., has purchased the inventories, machinery, and equipment, with drawings, designs, and certain other assets, of GOULD & EBERHARDT, INC., of Irvington, N. J. Manufacture of Gould & Eberhardt's line of shapers and gear-hobbing machinery will be continued in Worcester in Norton's machine tool plant. Sales of the Gould & Eberhardt line will be continued through their present distributors.

JOSEPH F. FLAVIN has been appointed New England district manager for the REED-PRENTICE DIVISION of Package Machinery Co., East Longmeadow, Mass., to handle direct sales of die-casting and plastic injection-molding machines. He will make his headquarters at the company's main office. WEST MARCELLUS has been appointed sales representative in Florida. His office is located at 1951 N.E. 183rd St., North Miami Beach.

COLONIAL BROACH & MACHINE CO., Detroit, Mich., and its COLONIAL-ROMULUS DIVISION have announced the appointment of the WETZEL TOOL CORPORATION, 221 Pitkin, East Hartford, Conn., and 386 Eastern Ave., Lynn, Mass., as their sales representative in Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, and all of Connecticut except Fairfield County.

FEDERAL PRODUCTS CORPORATION, Providence, R. I., announces the appointment of IRVING A. HUNT as manager of its recently expanded Contract Services Division, and of G. HOLMES WILSON as manager of sales promotion and advertising.

New York and New Jersey

CARBORUNDUM CO., Niagara Falls, N. Y., has announced three advancements in its research and development division. DONALD G. STURGES, formerly manager of the new products development branch, was promoted to associate director of the research and development division. FREDERICK J. ROSS, JR., formerly manager of the ceramic fiber project, was promoted to manager of the new products development branch. DR. WINGATE A. LAMBERTSON, formerly assistant to the manager, was promoted to assistant manager of the engineering research branch.

OAKITE PRODUCTS, INC., New York City, has announced two transfers and two new appointments in its technical field service organization. BEN P. FORTIN, formerly assigned to Tyler, Tex., has joined the Oakite staff in Los Angeles, where he will serve the metal industries. His post in Tyler has been filled by HENRY L. JONES. J. G. "JERRY" HICKEY has been transferred from San Francisco to Sacramento, Calif. WAYLAND E. WHITE has been appointed to the Corpus Christi territory.

(This section continued on page 205)

whatever your disc grinding job.....

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has a money saving answer!

Discover how YOU can profit by using Macklin discs. Write for bulletin DG-59.

For fast, accurate production you can depend on Macklin abrasive discs. Nut-inserted, bolt inserted, or plate mounted, each is custom built to your exact job requirements for standard disc grinding or vertical surface grinding.

Exactly matched, and uniform throughout, Macklin discs require less dressing, give greater stock removal and longer wheel life. *See for yourself* how Macklin discs cut free and clean; mount secure and flat. Consult your Macklin Sales Engineer or your nearest Macklin distributor. You'll find it's a money saving move!

Macklin discs are available in a complete range of sizes, types, and multiple gradings.

GRINDING WHEELS

MACKLIN company

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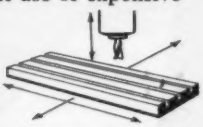
dual track RECORDING...

1 billion to 1 reliability in performance!

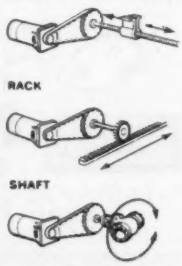
11 CHANNELS

Micro-Path's magnetic tape accommodates 11 individual tracks, allowing for many prime and auxiliary functions.

MICRO-PATH is the first low-cost automation system, recording programs directly without use of expensive computers or highly trained technicians. It utilizes magnetic tape and is capable of producing motion in any of 3 axes, *individually* or *simultaneously*.



To convert magnetic tape recordings to motion Micro-Path utilizes a special motor known as a PULSERVO. Unique in design, the PULSERVO responds to individual electrical pulses, the armature rotating 5° for each pulse command. A continual series of pulses thus creates continuous rotation, the PULSERVO keeping in step exactly and reversing according to the signal received. The PULSERVO can be attached as a packaged unit to a screw, rack or shaft to automate various types of equipment, from machine tools to industrial controls. This flexibility accommodates installation on existing equipment as well as easy incorporation in new designs.



With millions of pulses magnetically stored on each tape the question arises, how dependable is the MICRO-PATH system? During recording, motion commands for each axis are duplicated *in two separate channels*. Playback generates two identical electrical programs in exact unison. These are fed simultaneously to the PULSERVO. Loss even of a single pulse in one channel is remote, but should it occur, an identical pulse is supplied by the opposite track. Dual track recording in MICRO-PATH thus insures an electrical reliability of 1 billion to 1 at the recording head... *equivalent in machine tool operation to .001" in 15 miles of table travel!* Loss of program from external causes such as dust, scratches, wear or other similar defects is thus virtually nil! A closed loop Pulservo system thereafter faithfully follows commands and stays on program.

Our engineers will be glad to tell you how MICRO-PATH can automate your machines or equipment. For the complete MICRO-PATH STORY ask for brochure on your company letterhead!

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NEW CATALOGUES

EDUCATIONAL WALL CHART—DoALL Co., Des Plaines, Ill. An educational wall chart, 22 × 34 inches, entitled "The Dawn of This Age," suited for schools, libraries, banks, institutions, business offices, and plant information centers. The poster records the 157 major events that comprise man's spectacular period of progress, the Industrial Revolution. It describes the conditions that made this rapid advance possible. Available at a cost of 50 cents, or in quantities of 100 or more at 25 cents each.

NON-FERROUS CASTINGS — Non-Ferrous Founders' Society, Evanston, Ill. Alloy specification and property chart and the first two of a series of case histories illustrating particularly successful applications of non-ferrous castings. The chart covers the most common copper-base and aluminum-base alloys. It may be obtained through a request made on letterhead to Non-Ferrous Founders' Society, 1604 Chicago Ave., Evanston, Ill.

INTERNATIONAL INCH—Pratt & Whitney Co., Inc., West Hartford, Conn. Booklet entitled "The New International Inch . . . And How It Will Affect Your Operations" that discusses the various problems a manufacturer can be expected to encounter as a result of change-over to the International Inch on July 1 of this year. It includes: a chart to determine if the difference between the old and new inches will be significant for specific dimensions and tolerances—and a chart for converting measurements made in U.S. inches to international inches. **501**

STRIP SOLUTIONS—MacDermid Inc., Waterbury, Conn. Technical data sheet No. 20, containing instructions on the use of "Metex DB" and "XB" acid electrolytic strips. "DB" solution will strip chromium, nickel, copper, or bronze plate from zinc-base die-castings, brass and aluminum, and "XB" solution will remove copper-, nickel-, and chromium-plated coatings from zinc-base die-castings. **502**

TURRET DRILLING MACHINES—Brown & Sharpe Turret Drilling Division, Inc., East Norwalk, Conn. Catalogue No. 1T, describing features of design and construction of the company's new Model A, Model B, and Model B-automatic turret drilling machines and work-positioning tables. Details of turret head; speed, depth, and tapping controls; automatic cycle assembly; power index; feed control; air control; work-positioning tables; and other features are illustrated. . .**503**

SPIROID GEARS—Spiroid Division, Illinois Tool Works, Chicago, Ill. Comprehensive manual titled "Lower Cost Design Begins with Spiroid Gears," to assist engineers in determining basic design requirements such as ratings, selections, center distances, bearing loads, and mounting methods. It illustrates the principle of Spiroid gears and includes sections on applications, manufacturing and dimensional design data. **504**

WELDING—Air Reduction Sales Co., a division of Air Reduction Co., Inc., New York City. Booklet (ADE 882) on Aircomatic (Airco's gas-shielded metal-arc process) welding of mild steel and low alloy steels with carbon dioxide (CO_2) shielding gas. It provides an illustrated description of both the conventional CO_2 and the recently announced dip transfer CO_2 processes. The booklet describes the fundamentals of the process. **505**

For Advertisements—Circle Numbers

| | | |

STANDARD POWER TOOLS—Delta Power Tool Division, Rockwell Mfg. Co., Pittsburgh, Pa. 66-page case book ("Blue Book") on industry's approach to low-cost tooling with standard industrial power tools. It contains sixty-five illustrated case histories that tell how Delta tools are used in combination with other tools; with automatic controls; and in special setups. **506**

STAMPING DESIGN—Dayton Rogers Mfg. Co., Minneapolis, Minn. Design suggestion sheets in booklet form and a bulletin, "Design Suggestion Samples," illustrating how small-lot stampings may be designed to obtain high quality parts at low cost. Problems involving materials, clearances, blank design, blanking, piercing, and forming are discussed. **507**

AIR HOISTS—Ingersoll-Rand Co., New York City. Catalogue (Form 5224-A) containing information on two of the company's lightweight, portable air hoists —the 1000-pound capacity hoist, which weighs 39 pounds and lifts its rated load at 45 feet per minute; and the 2000-pound hoist, which weighs 56 pounds and lifts its rated load at 22 feet per minute. **508**

COPPER - BASE ALLOYS — Bridgeport Brass Co., Bridgeport, Conn. Folder designed to assist in the selection of copper-based alloys for products and processes. A check list of applications of the most commonly used alloys is included. Composition, and physical and mechanical properties of the company's alloys, and the industry and government specifications which they meet, are also listed. **509**

ADJUSTABLE-SPEED DRIVES—General Electric Co., Schenectady, N. Y. Bulletin GEA-6806, describing the company's new 1/4- to 25-hp line of "Polydyne" mechanical adjustable-speed drives. It discusses principles of operation, configurations, and features of the drives, and shows how to select and specify them. Rating tables, information on mounting, and a description of accessories are included. **510**

PENCIL GRINDER—Rotor Tool Co., Cleveland, Ohio. Bulletin No. 61 giving the features and specifications of the new air-powered Rotor M1223, D-03 pencil grinder which can be used with small carbide cutters, burrs, mounted points, and drills for die touch-up work, pattern work, or similar applications. It is a powerful, bladed type air motor having high speed under load. **511**

SOCKET SCREW STANDARD—Standard Pressed Steel Co., Jenkintown, Pa. Bulletin containing specification and application data of a socket screw standard for the "1960 series" large-diameter-head socket-head cap screw. Detailed dimensional data of standard sizes from No. 0 through 1 inch in diameter and a tabulation of recommended seating torques for use in three common materials of different hardness are covered. **512**

TRACER TURNING TOOLS—Wesson Co., Detroit, Mich. Bulletin No. 459, describing a standardized line of "Multicut" tracer turning tools for standard 55-degree diamond-shaped throw-away carbide inserts. Applications for the various styles are illustrated, and complete dimensions and tolerances are included. Pictorial parts-price list shows minimum inventory of spare parts. **513**

MATERIALS HANDLING—Cleveland Tramrail Division of Cleveland Crane & Engineering Co., Wickliffe, Ohio. Booklet No. 2008-0, titled "Engineering and Application Data," on overhead materials-handling equipment. It covers carriers, cranes, tractors, track switches, grabs, and electrification. Studies of track design, peening, and stresses are given and a variety of installations are illustrated. **514**

GRINDING MACHINE—Landis Tool Co., Waynesboro, Pa. Catalogue S-59, giving details of the Landis 12- by 28-inch "Grindwell" universal grinder, a general-purpose precision cylindrical grinding machine for use in small-lot manufacturing in both large and small shops, toolrooms, maintenance departments, and for training purposes. **515**

MACHINE BRACKET DESIGN—Lincoln Electric Co., Cleveland, Ohio. Brochure, "Design Ideas No. 22," that discusses how to simplify design of machine brackets is available to engineers, shop supervisors, and executives. Methods of increasing product rigidity without increasing costs are presented. **516**

WELDERS—Lincoln Electric Co., Cleveland, Ohio. Bulletin No. 4608.1, describing operating features, construction details, and applications for a new line of "Idealarc TIG" welding machines which can be used for all manual arc welding applications: D.C. manual electrode, A.C. manual electrode, D.C. inert gas, and A.C. inert gas. **517**

PRESS BRAKES—Niagara Machine & Tool Works, Buffalo, N. Y. Bulletin 90 containing information on the company's redesigned and expanded line of Series IB press brakes which include 15-, 30-, and 60-ton machines. Specifications are given for eight models with bed lengths from 4 to 14 feet and bending capacities to 3/16 inch of mild steel. **518**

TURRET DRILLING MACHINE—Burg Tool Mfg. Co., Inc., Gardena, Calif. Bulletin describing the improved Burgmaster 1C six-spindle, sensitive, hand feed turret drilling machine which features a power indexing turret having twelve pre-selective spindle speeds from 325 to 4050 rpm, pre-selective, precision depth control, and optional equipment. ..**519**

SLITTERS—Yoder Co., Cleveland, Ohio. Revised 76-page brochure, "Slitting Lines for Coils and Sheets," containing information on design, selection, and operation of slitters and slitting lines. It includes time studies and analysis of op-

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erating cycles along with data on uncoilers, recoilers, coil cars, and scrap choppers. 520

CUTTING TORCH—Air Reduction Sales Co., a division of Air Reduction Co., Inc., New York City. Catalogue 823 (Form ADC 880) on Airco's complete line of machine cutting torches, tips, and accessories. The torches described may be used with oxygen and a fuel gas such as acetylene, propane, or natural or city gas. 521

THREADING LATHE—Gisholt Machine Co., Madison, Wis. Bulletin No. 1215 describing the Gisholt "Cri-Dan Model B" high-speed, semi-automatic, single-point threading lathe for generating all types of threads, including single or multiple start, coarse or fine, left- or right-hand, straight or tapered, and either internal or external. 522

SOLID CARBIDE END MILLS—Kennametal Inc., Latrobe, Pa. 12-page catalogue of solid tungsten carbide end mills. It describes a new line of precision ground, fluted end mills made in fifteen styles. A table of suggested feeds and cutting speeds for nineteen metals and non-metallic materials is included. . .523

CARBIDE TOOLS—Metal Carbides Corporation, Youngstown, Ohio. 68-page catalogue 59-G covering the company's complete product line which includes brazed tools and tips, "Klamp-Lok" toolholders, throw-away blanks, centerless blades, and rolling mill rolls. Technical data on the applications of "Talide" metal is also provided. 524

HIGH-SPEED INDEXING—Ferguson Machine Corporation of Indiana, St. Louis, Mo. Catalogue No. 108 giving data on high-speed, precision, roller gear drive indexing mechanisms for intermittent and oscillating motions. Information for calculating load requirements and designing an installation is included. . .525

GAS REGULATORS—Linde Company, Division of Union Carbide Corporation, New York City. Data sheet (Form 1295) describing a new line of industrial gas regulators without gages for use with oxygen, acetylene, or propane on either cylinders or manifolds. Complete specifications and operating data on these large-capacity, single-stage regulators are included. 526

STEEL TUBING—Superior Tube Co., Norristown, Pa. Data memorandum No. 24 describing the characteristics and applications of leaded C-1020 carbon steel tubing, developed especially for high machinability. Tables list the chemical composition and mechanical properties, and give minimum and maximum wall dimensions for various sizes of tubing. **527**

BLIND RIVETS—Huck Mfg. Co., Detroit, Mich. Revised brochure (Form 8-388) describing and illustrating typical applications of the Conical Keystone Lock blind rivet for structural fastening. Complete dimensional information is given in tabular form and recommendations regarding hole preparation, inspection, and grip range are included. 528

TABLES AND FORMULAS—Westinghouse Electric Corporation, Pittsburgh, Pa. 120-page Booklet B-3677D, "Convenient Tables and Formulas," including convenient tables, formulas, and graphical symbols summarizing electrical data, properties of materials, heat transfer and steam information, measurements, and other subjects. 529

ADJUSTABLE-SPEED DRIVES—Speed Variator Division, Cleveland Worm & Gear Co., Cleveland, Ohio. Bulletin No. K-250, discussing adjustable-speed and drive control problems. It has eight pages of typical applications, along with methods and types of remote and automatic control, plus variable-speed bedplate assemblies. 530

SEALANT—American Sealants Co., Hartford, Conn. Brochure describing easier tolerances and improved alignment made possible with new techniques for retaining anti-friction bearings with "Loctite" sealant. It also contains information on how to prevent loose nuts and bolts and how to seal joints against high fluid pressures with the product. . .531

SINGLE - SPINDLE AUTOMATICS — Cleveland Automatic Machine Co., Cincinnati, Ohio. Bulletin B-359, giving detailed description and specifications of their newly designed 1 5/8- and 2 1/2-inch capacity Model B and Model B- 18-inch automatics, which are used for work involving multiple diameters, shoulders, and tapers, etc. 532

NUMERICAL POSITIONING CONTROL —General Electric Co., Schenectady, N.Y. Bulletin GEC-1531, describing in detail G-E's complete line of standard, pre-engineered, point-to-point numerical positioning control "packages" for use on any machine requiring point-to-point positioning of linear or rotary motion members. 533

BALL BEARINGS—Hoover Ball & Bearing Co., Ann Arbor, Mich. Bulletin No. 110 containing information about the available types and sizes of Hoover deep-groove ball bearings. Dimensions,

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loads, and other data for these Conrad type bearings are included 534

SCREW AND NUT ASSEMBLIES—Jerpbak-Bayless Co., Solon, Ohio. Brochure containing information on precision actuator screw and nut assemblies that are available in all sizes, from sub-miniature up, for use in atomic reactors, missiles, aircraft, radar, machinery, instruments, etc. 535

INDEXING UNIT—Standard Tool & Mfg. Co. Kearny, N. J. Bulletin presenting Model St-A9A cam-operated indexing unit and describing their basic indexing and locking units in three styles. ...536

CUTTING TOOLS—Illinois Tool Works, Chicago, Ill. Consumer price catalogue No. 105, listing and describing a complete selection of "Illinite" standard end mills and milling cutters. It contains many new items and sizes in the end-mill section. 537

MACHINE TOOLS — Walker - Turner Power Tool Division, Dept. 1009, Rockwell Mfg. Co., Pittsburgh, Pa. 48-page catalogue WT-50-9 presenting the complete line of the company's light-heavyweight machines and accessories. ...538

SPEED INDICATION—Jones Motrola Corporation, Stamford, Conn. Catalogue No. 61, giving technical data regarding Jones hand tachometers, Models 1600, 3200, 4800, 1HT, and 3HT. It also contains information on sizes and ranges, standard accessories, and prices. ..539

PUNCH PRESSES—Service Machine Co., Chicago, Ill. Condensed catalogue featuring twenty-two floor model Rousselle punch presses, six bench models, and the new "Econo-Air" friction clutch and brake. Specifications and a table on punching and shearing data are included 540

INDEXING UNITS—Standard Tool & Mfg. Co., Kearny, N. J. Bulletin illustrating the company's cam-operated indexing units, Models ST-A9B, ST-A9C, and ST-A9D. Tables of load rating and production per hour at various loads, stations, and dial plates are included. 541

STEEL TUBING TOLERANCES—Peter A. Frasse & Co., New York City. Data Chart Sec. B No. 1 that fully explains tolerances for both seamless and welded mechanical tubing, and seamless and welded stainless-steel tubing and pipe. 542

POLYPHASE MOTORS—Peerless Electric Co., Electric Motor Division, Warren, Ohio. Bulletin SDA 105, describing polyphase motors from 1/2 to 30 hp. Open drip-proof or totally enclosed, fan-cooled, explosion-proof types are illustrated. **543**

THREAD-ROLLING—Landis Machine Co., Waynesboro, Pa. Booklet describing the various applications of the Lanhyrol thread-rolling machine as pictured in a twenty-minute color-sound movie distributed by the company. 544

ALLOY—Haynes Stellite Co., Division of Union Carbide Corporation, New York City. Booklet containing data on Hastelloy alloy N, a nickel-base alloy developed as a container material for molten fluoride salts. 545

END-MILLING CUTTERS—Pratt & Whitney Co., West Hartford, Conn. Circular describing P & W "G" type end mills which feature eccentric radial relief. Illustrations and dimensions are included. 546

ANGULAR INDEXING—Michigan Tool Co., Detroit, Mich. Bulletin X59, presenting the accuracy and speed features of the "Ultradex" indexing table. ..547

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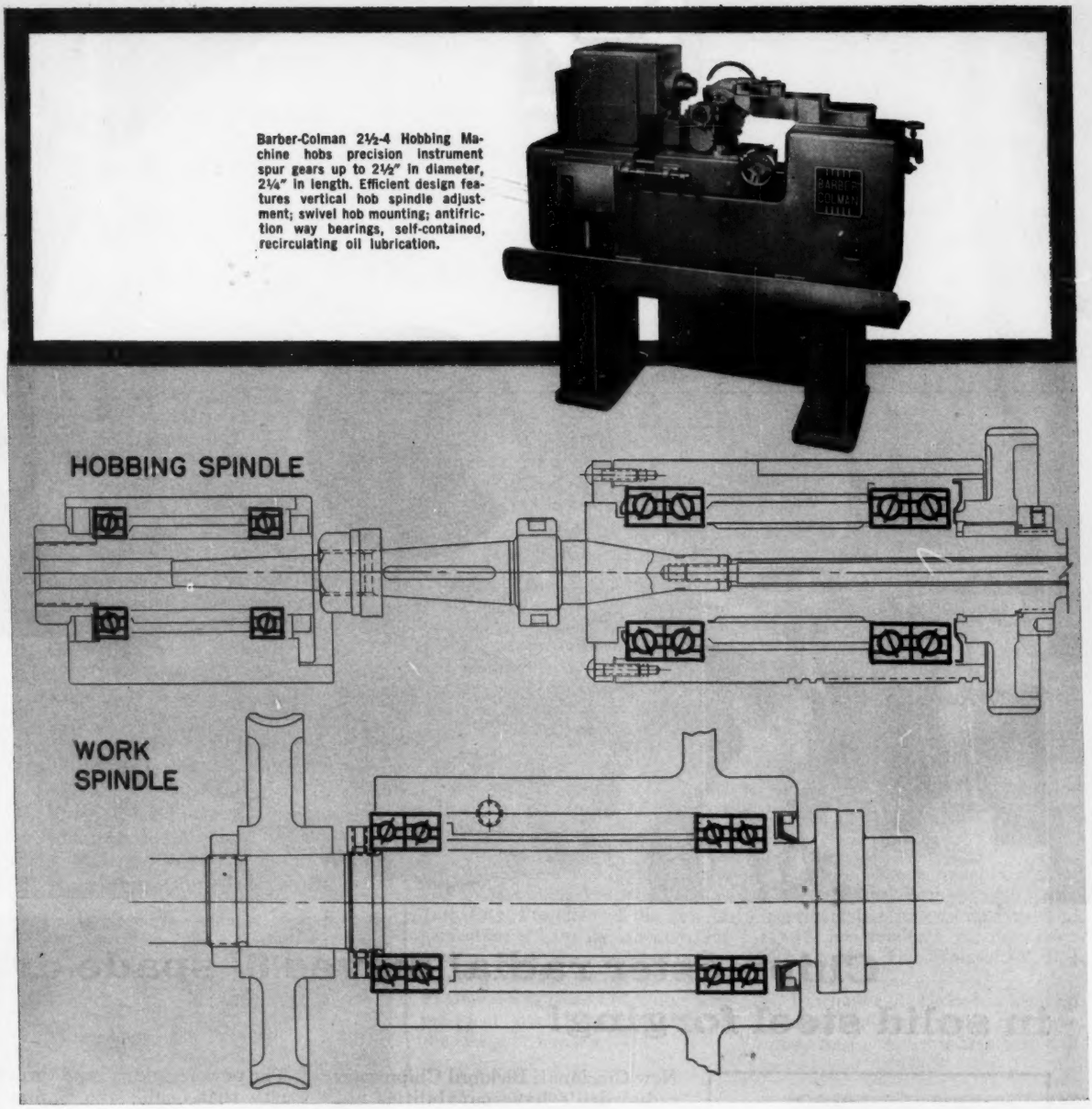
Barber-Colman 2½-4 Hobbing Machine hobs precision instrument spur gears up to 2½" in diameter, 2¼" in length. Efficient design features vertical hob spindle adjustment; swivel hob mounting; antifriction way bearings, self-contained, recirculating oil lubrication.
HOBBING SPINDLE
WORK SPINDLE

Relative rotation of hobbing machine spindles held accurate within 20 seconds using Fafnir Ball Bearings

New Barber-Colman 2½-4 machine precision-hobs spur gears for instruments

If two words can sum up the design of Barber-Colman's new 2½-4 Hobbing Machine, they are *accuracy* and *rigidity*.

Developed for hobbing AGMA Precision Class 3 fine-pitch spur gears for guidance systems, the 2½-4 has a minimum number of parts at points where deflection or inaccuracies might occur.

In selecting bearings which would complement the accuracy of the gears in the machine, Barber-Colman designers got the performance they wanted with Fafnir super-precision ball bearings. Single row, extra-light, counter-bore types, eight used in duplex pairs, help maintain indexing accuracy within *20 seconds*.

The application is typical of thousands Fafnir has handled where performance requirements put an extra premium on bearing selection. Chances are, Fafnir experience — plus breadth of line — can answer bearing problems you may have. Write The Fafnir Bearing Company, New Britain, Connecticut.

10 Fafnir Extra-Light Super-Precision Ball Bearings, snug fit, support the Barber-Colman 2½-4 machine spindles. 4 variations, equipped with composition retainers, are available in this one series to meet specific load and speed requirements where exceptional rigidity is wanted. •

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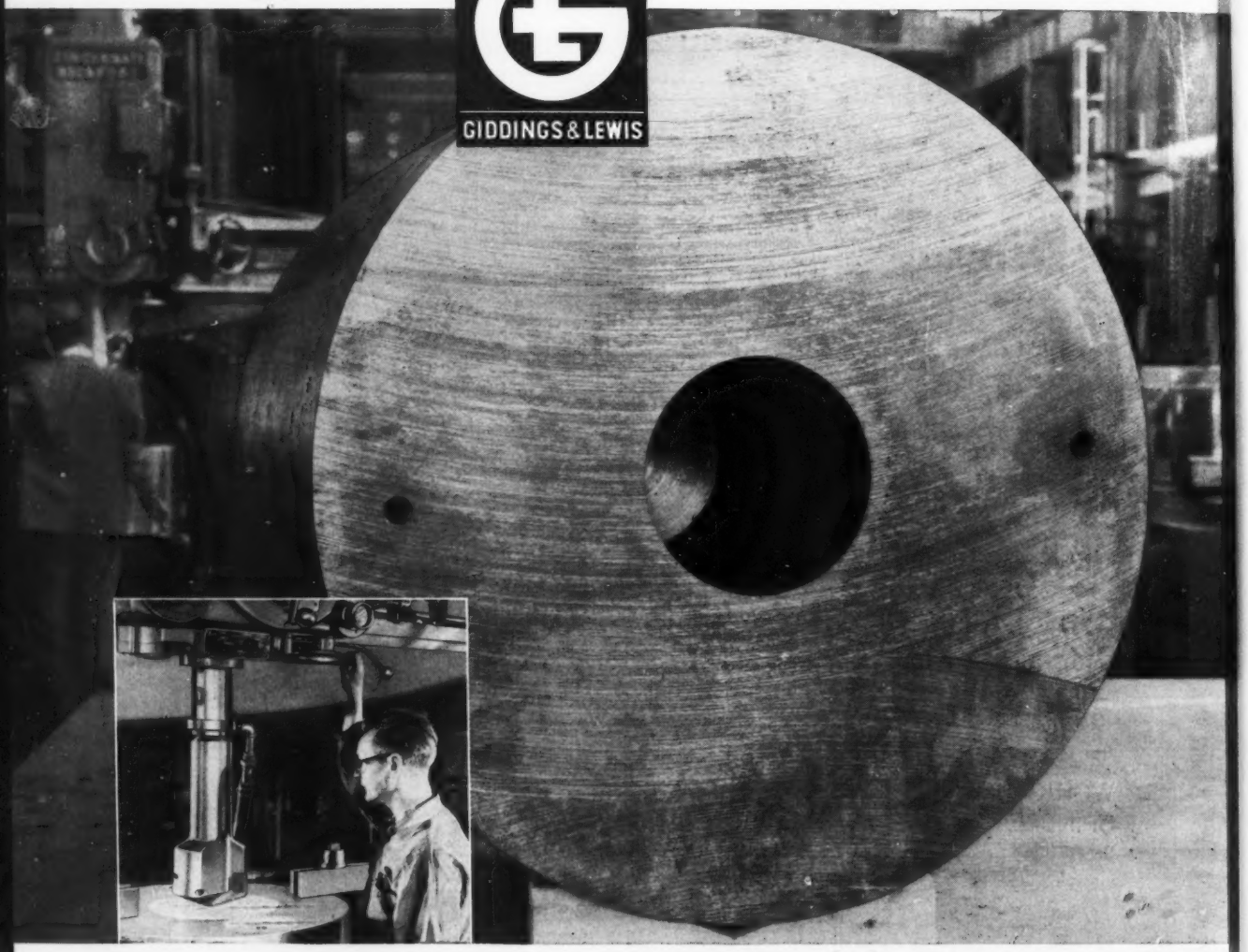
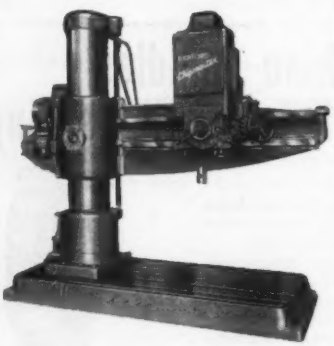


Chipmaster® radial drives 8″ spade drill in solid steel forging!



ALL-NEW CHIPMASTER®
the heavy-duty radial that does more than any before.

New Cincinnati Bickford Chipmaster radial drills have capabilities not approached by any other radial. The job above is a good example. An 8″ diameter hole, 18⅞″ deep, is spade drilled in solid SAE 4145 forged steel with a Brinell hardness of 200-240. The workpiece is a rolling mill drive coupling produced at Frank Kneeland Plant, United Engineering & Foundry Co., Pittsburgh. The machine is a 6′-19″ Chipmaster radial with a 25-hp motor.

The power, rigidity, and thrust capacity that enable the Chipmaster to handle this job will pay big dividends on any job. It means that you have the capacity to handle heavy drilling, boring, reaming, facing, trepanning, and spade drilling jobs. It means precision, accuracy, and maximum production. The Chipmaster can handle jobs now being done on slower or more costly machines.

For all the facts, call your Cincinnati Bickford distributor.

GIDDINGS & LEWIS MACHINE TOOL COMPANY

CINCINNATI BICKFORD DIVISION, Cincinnati, Ohio

Giddings & Lewis also manufactures: vertical and horizontal boring machines, vertical turret lathes, planers, planer mills, contour milling machines, die sinking machines, drilling machines, numerical and tracer control systems, boring tools and related items, and machine tool accessories.

High thrust capacity is key to capability of Chipmaster radial

You can't put too much thrust on a Chipmaster—and there's no vertical slop or backlash. The heavy-duty spindle rides on a quadruple bank of precision preloaded bearings. It never feeds away from its support—spindle, sleeve, and bearings move together.

The spindle sleeve travels in a 17½" honed head bore to provide rigidity for heavy feeds and accurate single-point boring. Both spindle and sleeve are heat-treated chrome nickel alloy steel. Spindle sleeve is hard chromium-plated.

Short, stubby column. Height over the Chipmaster column is up to 17⅞" less than that of other radials without sacrificing work height capacity. Column sleeve rides on precision preloaded bearings. This short, rigid column resists the deflection imposed by terrific thrust loads of heavy operations like that illustrated at the left.

Before you buy a radial, watch the all-new Chipmaster work.

Here's the chip that proves the difference

Ask your Cincinnati Bickford distributor to show you the big chip made at .100" feed, 45 rpm, with a 3" twist drill driven in solid steel by a Chipmaster radial! No other radial, regardless of size, can perform this feat.

symbol for machining cost reduction

GIDDINGS & LEWIS T.M.

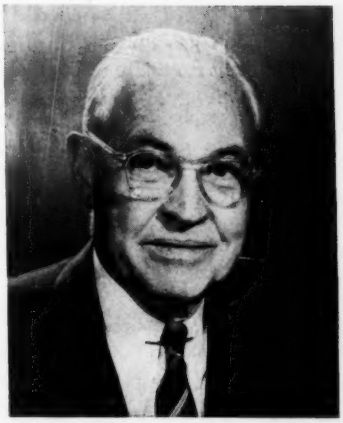
CB-111

JOSEPH T. RYERSON & SON, INC., Buffalo, N. Y., is now stocking and selling Reynolds aluminum in addition to its service on steeel. LAWRENCE T. BEALE, head of the steel sheet and strip department, has been named manager of aluminum sales. He retains his former responsibilities. DONALD E. HOLLAND, assistant to Mr. Beale, has been appointed a sales representative for the aluminum and steel sheet and strip department.

OLIVETTI CORPORATION OF AMERICA, Long Island City, N. Y., and STANDARD FINANCIAL CORPORATION, New York City, have arranged for distribution, sales, and financing of the Italian company's line of machine tools. They are being distributed and serviced in the United States by Olivetti's Machine Tool Division.

ETTCO TOOL & MACHINE CO., INC., Brooklyn, N. Y., has announced acquisition of the AUTO-TAP DIVISION of Automatic Methods Corporation, Hialeah, Fla. All Auto-Tap inventory and equipment will be moved to Ettco's Brooklyn plant, located at 594 Johnson Ave.

VAN NORMAN MACHINE TOOL CO. and VAN NORMAN AUTOMOTIVE EQUIPMENT, divisions of VAN NORMAN INDUSTRIES, INC., have been consolidated into one firm, known as VAN NORMAN MACHINE CO., New York City. President of the new organization is PAUL W. LEMING, former executive vice-president of Van Norman Machine Tool Co. SELBY F. GREER was named executive vice-president in charge of all sales for the merged company.



John S. Davey, vice-president in charge of sales, Russell, Burdsall & Ward Bolt and Nut Co.

JOHN S. DAVEY has been elected vice-president in charge of sales for Russell, Burdsall & Ward Bolt and Nut Co., Port Chester, N. Y. Mr. Davey has served R B & W in executive engineering, marketing, and production capacities for thirty years, most recently as vice-president in charge of research and engineering.

EDWARD R. BURKARDT has been elected vice-president in charge of tool sales of J. H.WILLIAMS & CO., a division of United-Greenfield Corporation, Buffalo, N. Y.

VIKING TOOL & STEEL CO., Buffalo, N. Y., has been appointed sales representative in western New York State for products of the TAFT-PEIRCE MFG. CO., Woonsocket, R. I.

LAWRENCE R. DOTY has been appointed industrial sales promotion manager for A. Schrader's Son, a di-

(Left) Paul W. Leming, president, and (right) Selby F. Greer, executive vice-president, Van Norman Machine Co.

For more data, circle this page number on inquiry card

vision of Scovill Mfg. Co., Inc. He will be located at the Schrader headquarters, 471 Vanderbilt Ave., Brooklyn 38, N. Y.

RIVETT LATHE & GRINDER, INC., Boston, Mass., has appointed the R. C. NEAL CO., INC., 76 Pearl St., Buffalo, N. Y., as exclusive distributor in western New York for Rivett air and hydraulic valves, cylinders, and power units.

GEORGE F. HALFACRE has been elected vice-president in charge of manufacturing of the NEW JERSEY ZINC CO., New York City. Mr. Halfacre succeeds PHILIP M. GINDER, who has retired.

CROSS COMPANY, Detroit, Mich., has acquired STEPHEN F. MALAKER ASSOCIATES, consultants in the nuclear and electronics fields. The new, wholly owned subsidiary has been re-named CROSS-MALAKER LABORATORIES, INC., and new research laboratories and administrative facilities have been established in Mountainside, N. J.

JOHN S. KLINE has been appointed general manager and chief executive of the CARPENTER STEEL CO.'s Alloy Tube Division, Union, N. J. He succeeds PHILIP L. CODDINGTON who has retired. Mr. Coddington has been retained as a part-time consultant.

ALBERT G. GALLER has been appointed an abrasive engineer by NORTON CO., Worcester, Mass. He will cover the northern New Jersey area. Mr. Galler was formerly a field engineer at the company's Teterboro, N. J., office.

Ohio

TIMKEN ROLLER BEARING CO., Canton, Ohio, has announced eleven advancements in its various divisions. R. K. MCCONKEY has moved up to general manager of the Industrial Division. Succeeding Mr. McConkey to the position of assistant general manager is WYN E. MCCOY. A. E. MATEJKA has been promoted to chief product engineer, Engineering Division, with C. L. GEORGE filling the role of assistant chief product engineer. Named to the post of chief engineer, Rock Bit Division, is R. H. HOLSING. The new Boston district manager of the Industrial Sales Division is TOM ROBINSON.

In Timken's International Division, S. C. PARTRIDGE has been promoted from general manager to director of sales. Named as chief engineer is JOHN B. BAKER. A new post, manager of sales planning, is filled by EDWARD H. HUGHES. ROBERT W. LANG has been named assistant to the manager of sales planning. Manager of production planning is CHARLES L. RICHEY.

NATIONAL ACME CO., Cleveland, Ohio, has announced two new appointments. R. B. SMITH has assumed the position of regional sales manager of the company's newly defined western district territory, including Canada. Mr. Smith will operate from the firm's main office in Cleveland. ELLISON MACHINERY CO., 160 W. 33rd St., Los Angeles 7, Calif., has been named as the company's representative in southern California and Arizona.

VINCENT W. STEHLIN, formerly purchasing agent and assistant general manager of the FOSDICK MACHINE TOOL CO., Cincinnati, Ohio, has moved up to the position of assistant purchasing agent with Fosdick's parent company, R. K. LEBLOND MACHINE TOOL CO., also of Cincinnati. CHARLES A. DEVRIES, former plant engineer, has become purchasing agent and assistant to the president of Fosdick.

RICHARD J. DIETZ has been appointed district sales representative for the E. W. BLISS CO., Canton, Ohio, covering the northern Ohio and Indiana territory. Mr. Dietz will assume those duties formerly handled by E. C. DEVAULT, who has been appointed to the new position of service manager, Mid-West area, including the Detroit and Dayton territories.

General Electric Co.'s METALLURGICAL PRODUCTS DEPARTMENT, Detroit, Mich., has moved its Cleveland office to 130 Northfield Road, Bedford, Ohio. It is headquarters for five states, including parts of Kentucky, Pennsylvania, New York, Ohio, and West Virginia.

E. W. BLISS CO., Canton, Ohio, has announced a decision to sell its inactive manufacturing facilities in Toledo. Manufacture of Bliss machines formerly made at Toledo has been consolidated at the company's other plants.

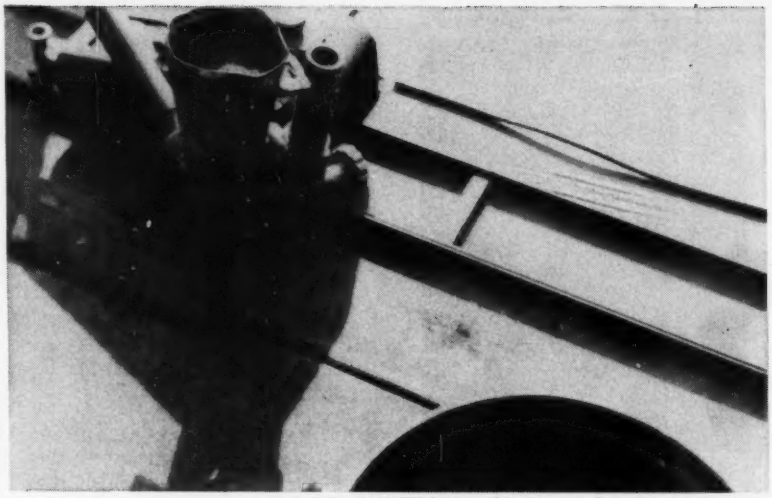
ROBERT L. GROVES has been appointed to the post of administrative assistant, sales department, of the WARNER & SWASEY CO., Cleveland, Ohio. Mr. Groves returns to this country from Paris, France, where he has served as European district manager for the company since 1956.

J. E. "JACK" SACKETT has been promoted to service and quality manager of the Parker Hydraulics Division, Parker-Hannifin Corporation, Cleveland, Ohio.

ROBERT E. MCKEE has been appointed sales manager for the R. K. LeBlond Machine Tool Co., Cincinnati, Ohio.

(This section continued on page 208)

(Left to right) R. K. McConkey, general manager, Industrial Division; A. E. Matejka, chief product engineer, Engineering Division; S. C. Partridge, director of sales, International Division; and John B. Baker, chief engineer, International Division, the Timken Roller Bearing Co.



A "Squirt" Welder welds heavy plate in 1/4 the time.

WAR AGAINST HIGH COSTS NETS BARGE BUILDER 75% BONUS

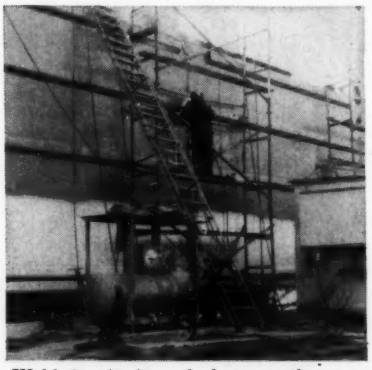
The Wiley Manufacturing Company of Fort Deposit, Maryland, builder of welded barges and large custom built cranes, initiated a cost reduction program that resulted in real savings.

Stanley Welsh, general superintendent, and J. J. Evans, general foreman, faced with ever rising labor costs, decided bold action was necessary if the company was to keep prices competitive. Since welding is the largest single operation in the Wiley yards it was only logical that they should look for a way to reduce welding costs first.

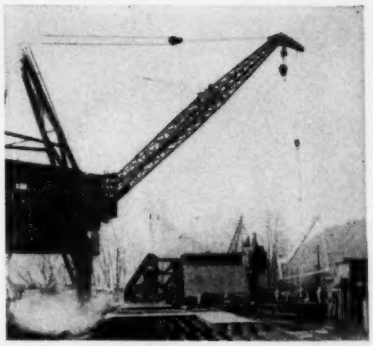
Enlisting the aid of Joe Gulley, a Lincoln welding engineer out of Lincoln's Baltimore office, the Wiley men began a detailed survey of their welding procedures and processes.

Mr. Gulley assisted Mr. Evans and his weldors to analyze the methods and electrodes used for welding sub-assemblies and for joining the sub-assemblies to the main structure. It was found that by positioning the smaller units iron-powder Jetweld electrodes could be used and speed increased considerably.

The jack-pot, though, was won by switching to semi-automatic



Welded units form the barge on the ways.



Structural members are fabricated on the ground with Jetweld, then welded into sub-assemblies.

Jack Evans, General Foreman at Wiley, sparked a cost reduction program that succeeded.

for welding of heavy plate. By using a Lincoln "Squirt" welder propelled on a gas cutting buggy, Wiley is able to weld heavy plate, up to ¾ inch, in ¼ the arc time previously required to weld it manually.

Mr. Evans states that these savings are made even greater because very little plate preparation is necessary. Bevel is eliminated in plate up to ½" and weld cleaning is greatly simplified. The resulting welds are better, too, than can be made manually.

The result—a 75% saving in arc time on this operation!

Although no overall cost figures were immediately available, Mr. Evans estimated that they had been able to reduce total welding costs by at least one third.

The World's Largest Manufacturer of Arc Welding Equipment

LINCOLN®

THE LINCOLN ELECTRIC COMPANY • DEPT. 1455 • CLEVELAND 17, OHIO

XUM

Howard W. Carlisle, manager, Meta-Dynamics Division of the Cincinnati Milling Machine Co.

John Moxon, who was recently elected president of the Carpenter Steel Co.

HOWARD W. CARLISLE has been appointed manager of the META-DYNAMICS DIVISION of the Cincinnati Milling Machine Co., Cincinnati, Ohio. He replaces E. D. VANCIL, who has retired.

Pennsylvania, Maryland, and Kentucky

CARPENTER STEEL CO., Reading, Pa., has opened a mill branch warehouse and specialty steels service center in the Fort Washington Industrial Park and Office Center, suburban Philadelphia. It will serve eastern Pennsylvania's Delaware Valley. ROBERT A. KOKAT, Philadelphia district manager, will direct operations at the new center.

SKF INDUSTRIES, INC., Philadelphia, Pa., has announced two new appointments in its sales division. KENNETH W. SETON has been named manager of the sales contract department. WILLIAM L. RHODES assumes the position of regional marketing analyst for the mid-western sales region.

UNITED STATES STEEL CORPORATION, Pittsburgh, Pa., has announced the appointment of STEPHEN M. JENKS as executive vice-president–engineering and research. Mr. Jenks succeeds WALTER F. MUNFORD, who was elected president and chief administrative officer.

LESTER E. CARPENTER has been named a district sales manager for the eastern region of Rockwell Mfg. Co.'s Delta Power Tool Division, Pittsburgh, Pa. He will cover the state of Connecticut and part of Massachusetts.

JOHN MOXON has been elected president, and FRANK R. PALMER, chairman of the board, of the CARPENTER STEEL CO., Reading, Pa. Mr. Moxon was formerly executive vice-president. MR. Palmer, president since 1948 and veteran of forty-two years with Carpenter, fills a vacancy created by the death of J. HEBER PARKER in December, 1956.

WILLIAM B. BERGEN, formerly executive vice-president, has been elected president of the MARTIN CO., Baltimore, Md., in which capacity he will direct the functioning of the company's seven operating divisions. ADOLPH VLCEK, JR., has been appointed director of manufacturing at the Baltimore Division. He succeeds VERNON R. RAWLINGS, general manager of Martin's newly created Activation Division.

LOUIS V. ABRAMS has joined the PANGBORN CORPORATION, Hagerstown, Md., in the newly created post of administrative assistant to the president.

NELSON C. WALKER has been named executive assistant to the president of Green River Steel Corporation, Owensboro, Ky., a subsidiary of the Jessop Steel Co., Washington, Pa.

Obituary

VAL C. HART, field sales engineer for the Bullard Co., Bridgeport, Conn., in the metropolitan New York–northern New Jersey area since 1934, died in June. He was fifty-eight years of age.

New Books and Publications

1958 BOOK OF ASTM STANDARDS. Ten volumes; illustrated; 13,600 pages; 6 by 9 inches. Published by American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. Price, $116.

The American Society for Testing Materials has completed publication of its ten-part 1958 Book of ASTM Standards. The increase from seven to ten parts in 1958 was necessitated by a growth in size of individual parts to the point where they could no longer be bound economically and were becoming unwieldy in size.

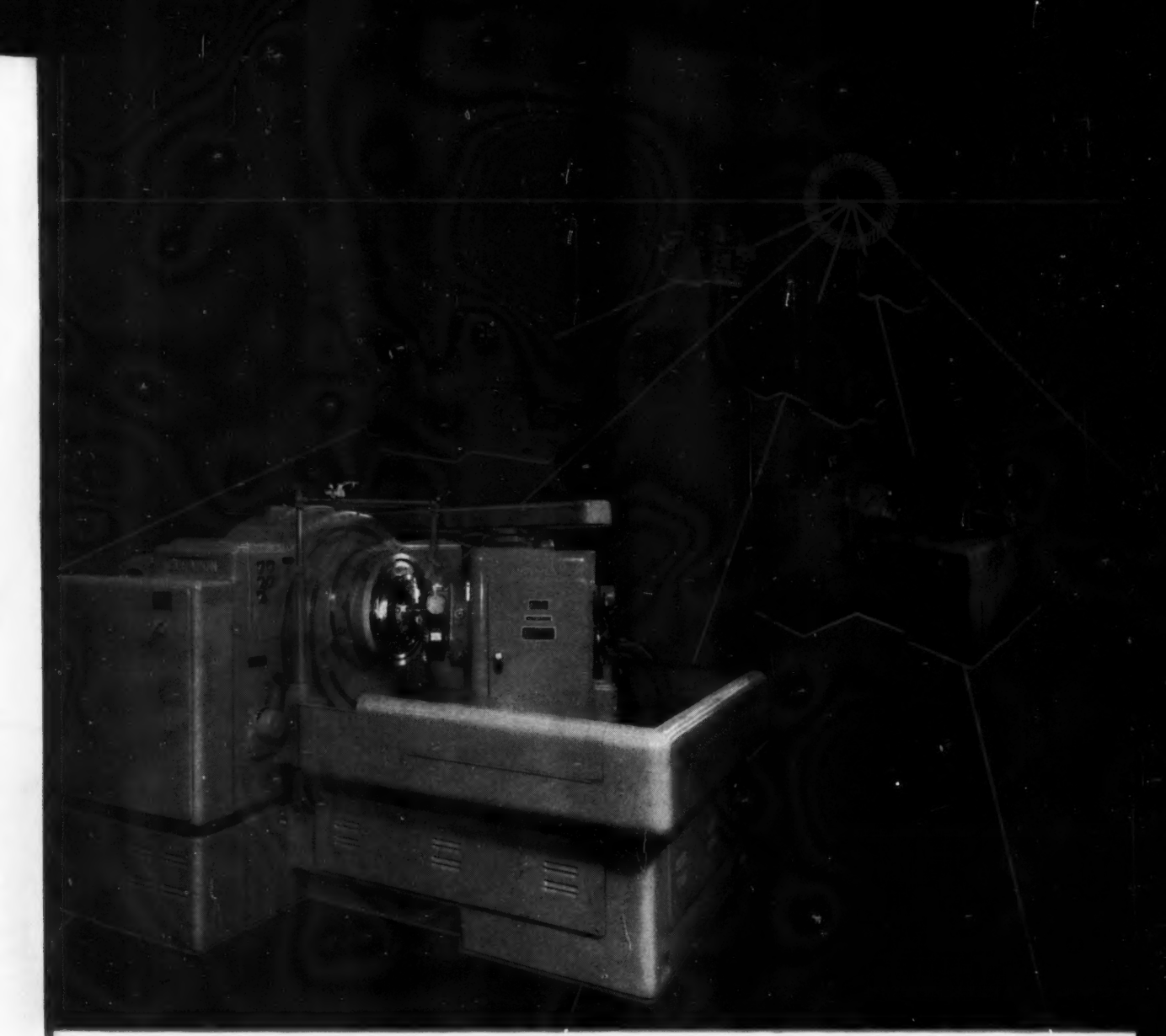
Within the ten parts will be contained 2450 standard specifications, methods of test, definitions of terms, and recommended practices. Each part is complete with a detailed subject index and a list of standards in numeric sequence.

To keep this book up to date, supplements will be issued to each part late in 1959 and 1960. As a service, a complete index is furnished without charge with each set of the Book of ASTM Standards.

AUTOMATION IN PRACTICE. By S. E. Rusinoff. 261 pages; illustrated; 5 1/2 by 8 1/2 inches. Published by American Technical Society, 848 E. 58th St., Chicago 37, Ill. Price, $6.50.

This is a practical work devoted to the methods and machinery of automated production in the metal industries. The volume begins with a lucid discussion of basic principles—"self-regulation," "negative feedback," the theory of "closed loop" control systems, etc.—and proceeds to the concrete application of these principles in the major types of control devices employed in today's automated and semi-automated plants. Other chapters are devoted to the use of automatic equipment in virtually every area of metal production.

(Continued on page 210)



Now . . . one machine does the work of five!

For small production runs—here's *one* gear-cutting machine with the flexibility of *five!*

The Gleason No. 118 Hypoid Generator roughs and finishes both gears and pinions—using four cutting methods that formerly required a battery of five machines. When production requirements increase, you simply add other machines, the 118 becoming a specialized member of your production team.

1. Single-Cycle® Method. Using this method, you can cut nongenerated gears four to five times faster than previously possible on machines of this type. Cradle and work head are locked in position. The last rotation of the Single-Cycle Cutter finishes both sides of a tooth space. You cut the mating pinions on the same machine, using the conventional single-roll generating method.

2. Cyclex® Method. For certain applications you can use the extremely fast Cyclex Method on the No. 108 Generator. You cut nongenerated gears in one completing operation from the solid blank.

3. Generated Gears and Pinions. You can produce both gears and pinions on this machine with the generating method. Here, a relative rolling motion takes place between gear or pinion and the rotating cutter. Once the gear is chucked in the work head, the machine operation is entirely automatic.

4. Unitool* Method. If you want to cut small quantities of spiral bevel, Zerol® bevel, or hypoid gears with a minimum of tooling, you can use the Unitool Method. You cut both gears and pinions with a single cutter. This method is particularly useful for experimental gears for prototype work.

*Trademark

The No. 118 Hypoid Generator handles gears up to 18″ diameter at a 10:1 ratio, to a *maximum* coarseness of 2 DP. For production of smaller gears, the No. 108 Generator cuts gears up to 8½″ diameter at a 10:1 ratio and to 4 DP. A third model, the No. 28 Hypoid Generator, cuts gears up to 33″ diameter at a 10:1 ratio, 1½ DP.

For complete information, send for bulletins on all three machines.

GLEASON WORKS

1000 UNIVERSITY AVE., ROCHESTER 3, N.Y.

XUM

FLUID-POWER CONTROLS. By John J. Pippenger and Richard M. Koff. 254 pages; 6 by 9 inches; 302 illustrations. Published by McGraw-Hill Book Co., Inc., 327 W. 41st St., New York 36, N. Y. Price, $9.

This volume is a practical guidebook on controls and valves for fluid-power systems. It describes their construction, operation, and proper use in the hydraulic circuit, and how to maintain them for best service. The full range of valves is covered—including those used in automated machines. The authors also discuss pumps, reservoirs, piping, development of hydraulic circuits, and methods of preventive maintenance and machine repair.

Life expectancy of the components, limitations of service, and best choice of component design are treated in an objective manner. The book explains the growth of "extreme dependability" units for the automation of machinery. Among these components are the oil-immersed solenoid, the independently drained pilot mechanisms, diaphragm seals, hydraulic fuses, and port seals recently adopted by the SAE.

Schematic drawings are blended with cut-away drawings to help the reader understand components both as units for maintenance and as portions of a complete circuit.

Reviews of Available Motion Pictures

SCREW MACHINE TOOLING APPLICATIONS

A 16-mm, color-sound film, "Engineered Screw Machine Tooling Applications," featuring eight practical applications of the latest designs in automatic screw machines, is available from Brown & Sharpe Mfg. Co., Providence, R. I. Running time of the film is approximately thirty-five minutes. Utilizing close-up views and slow motion, some of the sequences detail the relative position of tooling during close timing operations. Standard and special attachments with explanations of the tool engineering involved in their practical application are featured.

Each of the eight applications in the film is detailed to explain the "how" and the "why" of tooling technique. This film should prove interesting and valuable to management, production-design and engineering people, and to technical-society and trade groups. Pinpoint camera positions are employed to produce the most definitive views of the operations described and slow motion focusses attention on critical details.

"Engineered Screw Machine Tooling Applications" is available on a no-charge loan basis from Brown & Sharpe Mfg. Co., Machine Tool Division, Providence 1, R. I., and from local Machine Tool Division sales offices.

ALUMINUM FROM ADAM TO CAPE CANAVERAL

Entitled "A Product of the Imagination," Aluminum Company of America's new color film is being released publicly. From mine to finished product, the film reviews the 70-year-old aluminum industry's past, present, and future in terms of processes, plants, and products. Viewers see how aluminum is forged, cast, rolled, drawn, extruded, and impacted—proving it is the most workable metal we know today.

Then, the picture looks into the "world of tomorrow," with Alcoa's internationally recognized "Forecast" creations in aluminum design illustrating some of the fantastic future possibilities for the wonder metal. It is a twenty-two-minute, 16-mm sound film. A 35-mm Eastman color negative is also available. Organizations desiring to borrow "A Product of the Imagination" should write Motion Picture Section, Aluminum Company of America, 1501 Alcoa Bldg., Pittsburgh 19, Pa.

THREAD-ROLLING MACHINE

Landis Machine Co., Waynesboro, Pa., has made available a 16-mm film in color, with sound, on the Landis "Lanhyrol" thread-rolling machine. Of twenty-minute duration, it explains in detail with illustrations and narration the three methods of rolling ("Infeed," "Continuous," "Thrufeed") by which the machine can be used for thread- and gear-rolling. In addition, it shows nine applications rolling as many different work-pieces to illustrate the utility value and versatility of the machine. The film is available by contacting the Advertising Department of Landis Machine Co.

MANUAL HELIARC WELDING

In this eight-minute sound and color 16-mm motion picture from the Linde Company, New York City, the beginner is given an orientation in Heliarc welding—how it works and what it can do. The movie shows the basic pieces of equipment and their relationship to each other, how to make a simple weld, and the excellent results that can be expected after practice. The film is available at no charge from any Linde office, as are other movies on Heliarc welding and other Linde electric-welding processes.

ELECTROSTATIC HAND GUN

Ransburg Electro-Coating Corporation, Indianapolis, Ind., has available for group showings a sound and color film entitled "Guided Mist." The eighteen-minute movie tells the story of Ransburg's newly developed No. 2 Process electrostatic hand gun. The new tool is shown in operation, both in laboratory and in-plant production shots. Versatility of the hand gun is exemplified in the painting of a wide variety of products ranging in size and shape from long outdoor lighting standards to toys, metal furniture, office partitions, water-heater jackets, and small pieces of door hardware.

As in the company's automatic No. 2 Process equipment, no compressed air is used for atomization in the hand gun. That is where the movie gets its title, "Guided Mist," for viewers see the mist of paint particles as they are "guided" to the work by electrostatic forces.

Coming Events

SEPTEMBER 28-OCTOBER 1—American Welding Society Fall Meeting to be held in the Sheraton-Cadillac Hotel, Detroit, Mich. AWS headquarters are at 33 W. 39th St., New York 18, N. Y.

OCTOBER 20-22—Sixth Annual Conference on Lubrication, jointly sponsored by the American Society of Lubrication Engineers and the American Society of Mechanical Engineers, will be held at the Sheraton-McAlpin Hotel in New York City. For additional information write to the American Society of Lubrication Engineers, 5 N. Wabash Ave., Chicago 2, Ill.

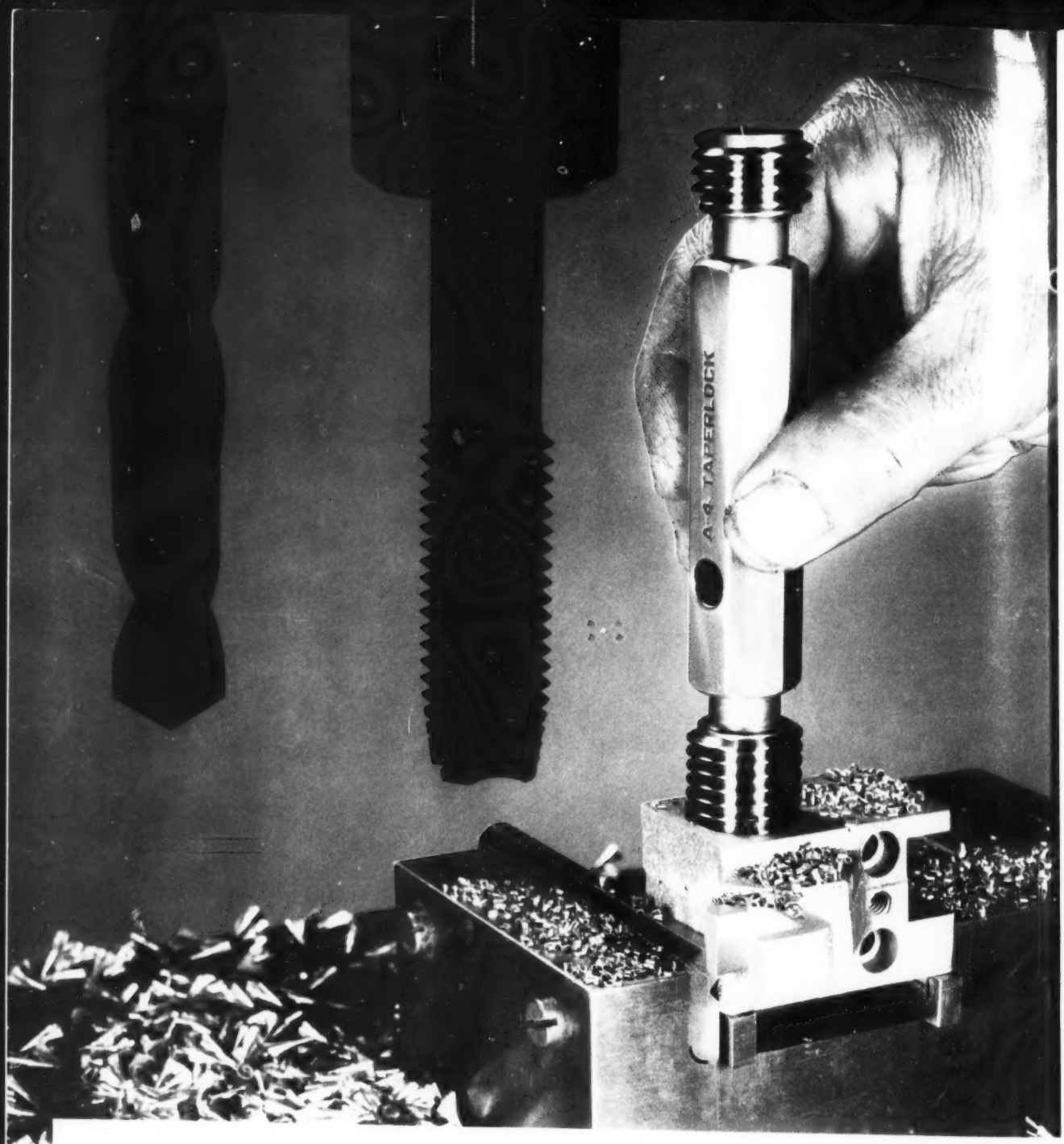
NOVEMBER 2-6—Forty-First National Metal Exposition and Congress to be held at the International Amphitheatre, Chicago, Ill. It is under the management of the American Society for Metals, 7301 Euclid Ave., Cleveland 3, Ohio; Chester L. Wells, director.

Look around your plant, you'll probably find nobody toting those bars and lifting those bales but be sure you are not trying to produce today's precision threads with antique or worn out die heads. Chances are that a new Geometric would give a lift to more than one threading job.

CALL YOUR GEOMETRIC DISTRIBUTOR TODAY

GEO MET RIC

NEW HAVEN 15, CONNECTICUT



Background For Perfection

Gages do "tell the story" of perfect threads. But back of *that* story you will find holes perfectly drilled, taps properly selected and correctly used, and engineering services freely given.

When tooling any threading job, get the whole story — specify GREENFIELD cutting Tools *and* GAGES.

Write for Greenfield Handbook "Facts About Taps and Tapping"

GREENFIELD TAP & DIE

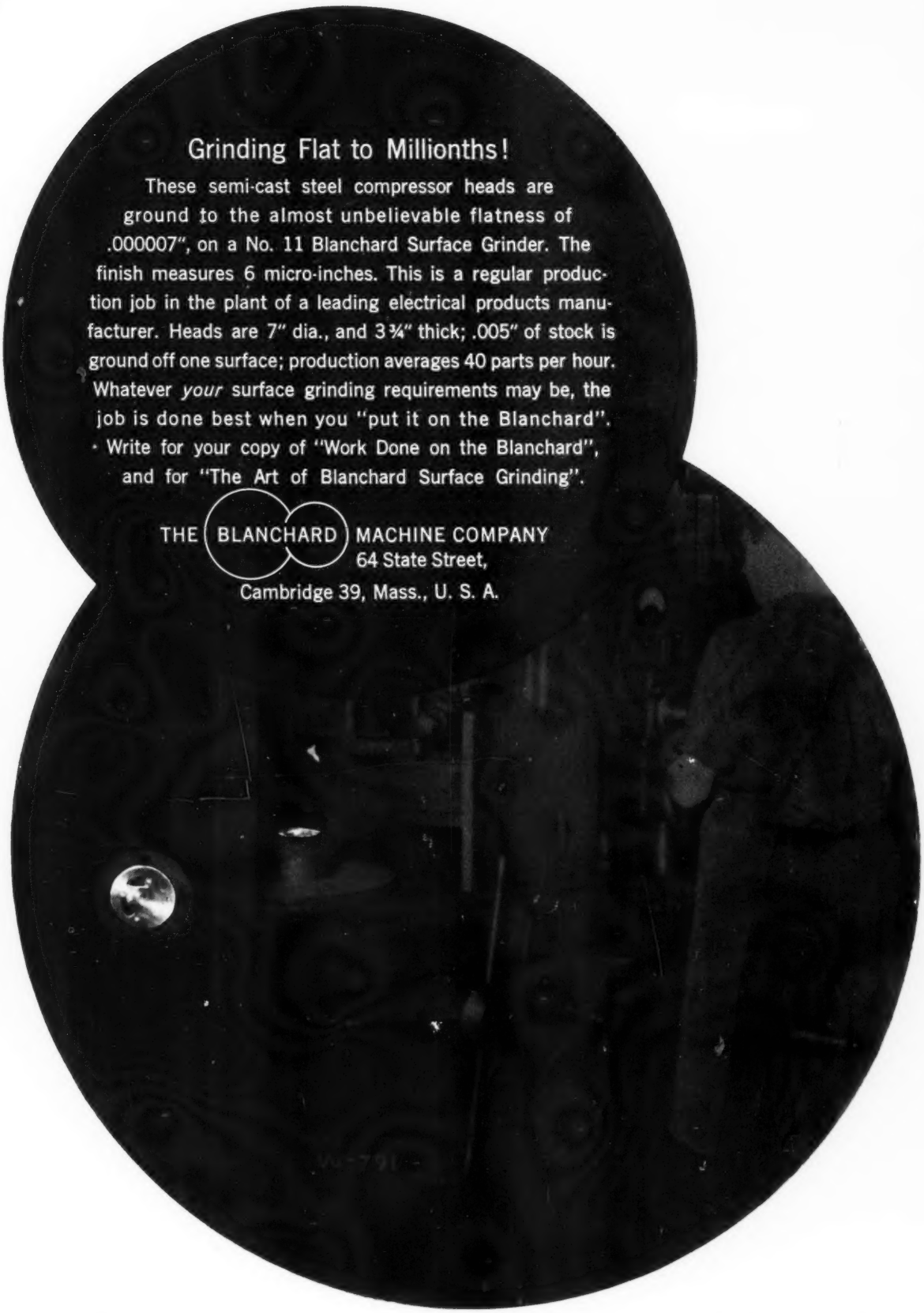
GREENFIELD, MASSACHUSETTS

Grinding Flat to Millionths!

These semi-cast steel compressor heads are ground to the almost unbelievable flatness of .000007", on a No. 11 Blanchard Surface Grinder. The finish measures 6 micro-inches. This is a regular production job in the plant of a leading electrical products manufacturer. Heads are 7" dia., and 3¾" thick; .005" of stock is ground off one surface; production averages 40 parts per hour. Whatever *your* surface grinding requirements may be, the job is done best when you "put it on the Blanchard".

· Write for your copy of "Work Done on the Blanchard", and for "The Art of Blanchard Surface Grinding".

THE BLANCHARD MACHINE COMPANY
64 State Street,
Cambridge 39, Mass., U. S. A.



For more data, circle this page number on inquiry card.

Product Directory

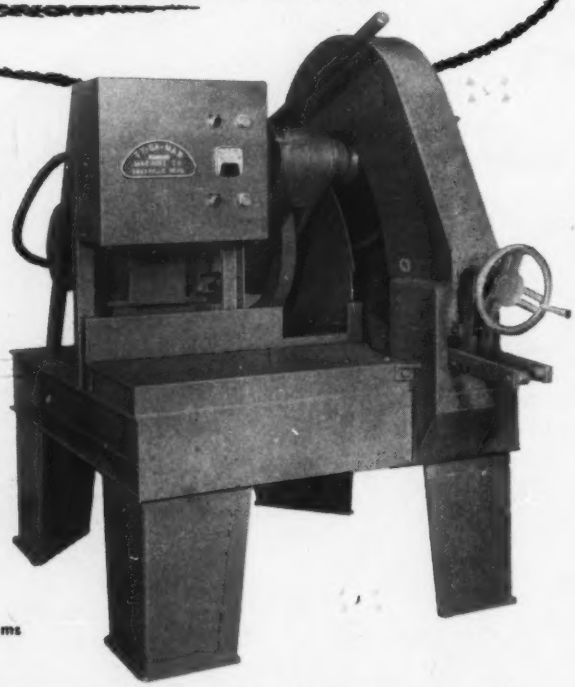
To find headings easily, look for capital letters at top of each page to denote location.

ABRASIVE CLOTH, Paper and Belt
Crane Packing Co., 6400 Oakton St., Morton Grove, Ill.

ABRASIVES, Disc
Gardner Machine Co., Beloit, Wis.
Macklin Co., Jackson, Mich.
Norton Co., 1 New Bond St., Worcester, Mass.
Simonds Abrasive Co., Tacony & Fraley Sts., Philadelphia 35, Penna.

ABRASIVES, Polishing, Tumbling, Etc.
Crane Packing Co., 6400 Oakton St., Morton Grove, Ill.
Macklin Co., Jackson, Mich.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Simonds Abrasive Co., Tacony & Fraley Sts., Philadelphia, 35, Penna.

New 30HP "CHOP" Saw Ends UNDERPOWER Problems



Cuts
- Steel structurals
- Bar stock
- Heavy cable
- Pipe
- Test sections
- Forging blanks
- Extrusion blanks
- High temperature alloys
- Rigging steel
- Fixtures and jigs
- Cross ties
- Heavy wooden beams

Now . . . power *when* you need it—*where* you need it—with the radically new 30 HP "CHOP" Saw for wet or dry cutting. Advanced features include more powerful main motor, sealed-bearing spindle, timing belt drive, and a new dynamic suspension system that permits light fingertip feed without springs, counterweights or adjustments. Provides straight or variable-speed oscillating feed at option of operator. Screw-operated double vise quickly adjusts to handle up to 8" x 8" sections or solids.

Ty-Sa-Man
SINCE 1885

Write for FREE BROCHURE
TY-SA-MAN Machine Co., Inc.
1093 White Ave., Knoxville, Tenn.

ACCUMULATORS, Hydraulic
Erie Foundry Co., 1253 W. 12th St., Erie Penna.
Wood, R. D., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

AIR GAGES, Dimensional—See Gages Air Comparator

AIR GUNS
Chicago Pneumatic Tool Co., New York, 17, N. Y.
Schrader's Sons, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.

AIR TOOLS—See Grinders, Portable, Pneumatic—Drills, Portable, Pneumatic, Etc.

ALLOY STEELS
Allegheny Ludlum Steel Corp., Pittsburgh, Pa
Bethlehem Steel Co., Bethlehem, Pa.
Jessop Steel Co., Washington, Penna.
Ryerson Joseph T., & Son, Inc., 2558 W. 16th St., Chicago 18, Ill.
U. S. Steel Corp., Carnegie-Illinois Steel Corp. Div., 436 7th Ave. Pittsburgh, Pa.
Vanadium Alloys Steel Co., Latrobe, Pa.
Wheelock, Lovejoy & Co., Inc., Cambridge, Mass.

ALLOYS, Bearing
Bunting Brass & Bronze Co., 715 Spencer, Toledo 1, Ohio.
Carpenter Steel Co., 105 W. Bern St., Reading Penna.
Mueller Brass Co., Port Huron, Mich.

ALUMINUM and Aluminum Products
Revere Copper & Brass, Inc., 230 Park Ave., New York 17, N. Y.
Ryerson & Son, Jos. T., 16th & Rockwell Sts., Chicago 8, Ill.

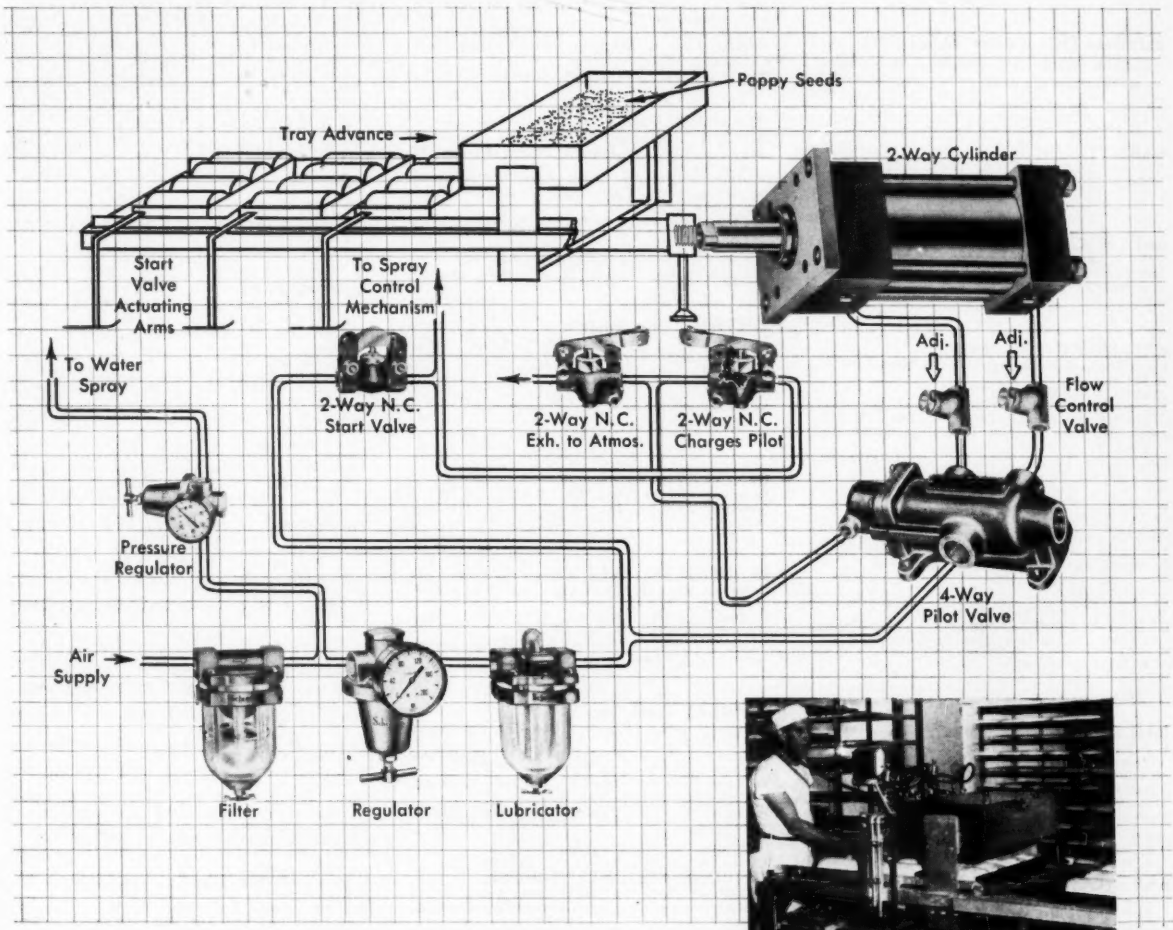
ANGLE PLATES—See Set-up Equipment

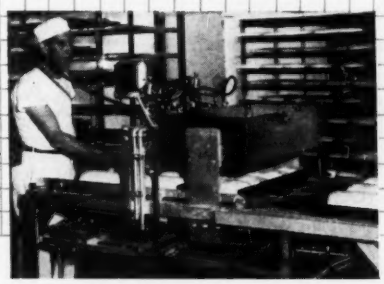
ANNEALING FURNACES
Eisler Engrg. Co., 750 So. 13th St., Newark 3, N. J.

ARBOR PRESSES—See Presses Arbor

ARBORS AND MANDRELS
Brown & Sharpe Mfg. Co., Providence, R. I.
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill. (end mills)
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland, Ohio.
Jacobs Mfg. Co., West Hartford, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Logansport Mich. Co., Inc., Logansport, Ind.

PLANT MAKES STANDARD SCHRADER AIR PRODUCTS DO 65% OF THE WORK AUTOMATICALLY





Here's a typical example of how companies can automate with air. The hookup of Schrader Air Products in the large picture was used to perform repetitive operations by General Baking Company, Detroit, Michigan. A tray of loaves moving on a belt trips a Schrader 2-way valve which actuates the water spray mechanism—and starts the 4-way valve-operated reciprocating system. The 4-way valve operates the cylinder which sifts poppy seeds onto each loaf in turn. This was formerly repetitive hand work. Schrader representatives helped plan this effective air system, as they have helped plan innumerable others.

Get full productive power from your manpower and machines, like this company. Simply take advantage of the *air* you already have! Hook up Schrader Air Products to fit your needs and get these benefits:

AIR IS FAST AND ACCURATE: time operations to fractions of seconds, produce at high speed. AIR IS TIRELESS: keeps going when fingers fail. AIR IS ECONOMICAL: saves you time, money and effort. AIR IS SAFE: reduces operator fatigue and machine-fear.

These are benefits every shop needs. Get them all when you automate with Schrader . . . the finest line of Air Cylinders, Valves and Accessories . . . and ideas for cutting your operating costs.

Use the full Schrader line to do your air control selecting. Your Schrader distributor can help you pinpoint what you need. For more data write:

A. SCHRADER'S SON
Division of Scovill Manufacturing Company, Incorporated
454 Vanderbilt Avenue, Brooklyn 38, N. Y.

Schrader®
a division of SCOVILL

QUALITY AIR CONTROL PRODUCTS

XUM

ARC WELDERS—See Welding Equipment, Arc

ASSEMBLING MACHINES
Detroit Power Screwdriver Co., 2799 W. Fort St., Detroit 16, Mich.
Lamb F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Sheffield Corp., Box 893, Dayton 1, Ohio

AUTOMATIC SCREW MACHINES—See Screw Machines, Single and Multiple-Spindle Automatic

BABBITT
Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

BACTERICIDES
Lilly, Eli and Co., Indianapolis 6, Ind.
Oakite Products, Inc., 26 Rector St., New York 6, N. Y.

BALANCING EQUIPMENT
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
DoAll Co., Des Plaines, Ill.
Gisholt Machine Co. (Static and Dynamic), 1245 E. Washington Ave., Madison 10, Wis.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sundstrand Mach. Tool Co., 2531 11th St., Rockford, Ill.

BALLS
Hoover Ball & Bearing Co., Ann Arbor, Mich.
Kennametal, Inc., Latrobe, Penna.

BAR MACHINES—See Screw Machines, Single and Multiple-Spindle, Automatic

BAR STOCK, Non-ferrous
Bunting Brass & Bronze Co., 715 Spencer, Toledo, Ohio
Mueller Brass Co., Port Huron, Mich.
Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.
Shenango Furnace Co., Dover, Ohio

BAR STOCK AND SHAFTING, Steel
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Boston Gear Works, 14 Hayward St., Quincy 71, Mass.
Carpenter Steel Co., 105 W. Bern St., Reading, Penna.
Jessop Steel Co., Washington, Penna.
Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

BEARING PILLOW BLOCKS AND CARTRIDGES
Fafnir Bearing Co., New Britain, Conn.

BEARINGS, Ball
Ball & Roller Bearing Co., Danbury, Conn.
Boston Gear Works, 3200 Main St., North Quincy, Mass.
Fafnir Bearing Co., New Britain, Conn.
Federal Bearings Co., Inc., Poughkeepsie, N. Y.
Hoover Ball & Bearing Co., Ann Arbor, Mich.
Marlin-Rockwell Corp., 402 Chandler Bldg., Jamestown, N. Y.
Nice Ball Bearing Co., 30th & Hunting Park Ave., Philadelphia, Pa.
S K F Industries, Inc., Philadelphia, Penna.

BEARINGS, Bronze and Special Alloy
Boston Gear Works, 3200 Main St., North Quincy, Mass.
Bunting Brass & Bronze Co., 715 Spencer, Toledo, Ohio

BEARINGS, Oilless
Bunting Brass & Bronze Co., 715 Spencer, Toledo 1, Ohio
Ryerson, Joseph T. & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

BEARINGS, Roller
Ball & Roller Bearing Co., Danbury, Conn.
International Ball & Roller Bearing Corp., 3123 Eastlake, Seattle 2, Wash.
Marlin-Rockwell Corp., 402 Chandler Bldg., Jamestown, N. Y.
Rollway Bearing Co., Inc., 541 Seymour St., Syracuse, N. Y.
S K F Industries, Inc. Philadelphia, Penna.
Sonnet Tool & Mfg. Co., Hawthorne, Calif (Milling Machine, arbor)
Timken Roller Bearing Co., Canton, Ohio

BEARINGS, Thrust
Ball & Roller Bearing Co., Danbury, Conn.
Bunting Brass & Bronze Co., 715 Spencer, Toledo, Ohio
Fafnir Bearing Co., New Britain, Conn.
Marlin-Rockwell Corp., 402 Chandler Bldg., Jamestown, N. Y.
Nice Ball Bearing Co., Nicetown, Philadelphia, Pa.
Rollway Bearing Co., Inc., Syracuse, N. Y.
S K F Industries, Inc., Philadelphia, Penna.
Timken Roller Bearing Co., Canton, Ohio.

BELTING, Transmission
Houghton, E. F. & Co., 303 W. Lehigh Ave., Philadelphia 33, Penna.

BELT SANDERS—See Grinding Machines, Abrasive Belt

BENCH CENTERS
Brown & Sharpe Mfg. Co., Providence, R. I.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.

BENDERS, Bar, Tube, Channel, etc.
Greenlee Bros. & Co., 2136—12th St., Rockford, Ill.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.
Wood, R. D., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

BENDERS, Plate, Etc.
Cincinnati Shaper Co., P.O. Box 111, Cincinnati 11, Ohio
Niagara Mch. & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.
Wood, R. D., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

BENDING MACHINES, Hydraulic
Bethlehem Steel Co., Bethlehem, Pa.
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Chambersburg Engrg. Co., Chambersburg, Pa.
Denison Engineering Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Hydraulic Press Mfg. Co., Mount Gilead Ohio.
Niagara Machine & Tool Works, 683 Northland Ave., Buffalo, N. Y.
Verson Allsteel Press Co., 93rd St. & S. Kenwood Ave., Chicago, Ill.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.

BENDING MACHINES, Pipe
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.

BENDING ROLLS
Cleveland Punch & Shear Works Co., 3917 St. Clair Ave., Cleveland, Ohio
Niagara Mch. & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.

BLAST CLEANING EQUIPMENT
Pangborn Corp., Hagerstown, Md.

BLOWERS
Buffalo Forge Co., 490 Broadway, Buffalo, N. Y.

BLUING LAYOUT
Dykem Co., 2307 N. 11th St., St. Louis 6, Mo.

BOLT and NUT MACHINES
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.

BOLTS, NUTS AND SCREWS
Allen Mfg. Co., Bloomfield, Conn.
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Northwestern Tools, Inc., 115 Hollier Ave., Dayton 3, Ohio.
Orban Kurt Co., Inc., 42 Exchange Place Jersey City 2, N. J.
Trans National Fabricators Corp. (T.N.F.), 1052 E. Elizabeth Avenue, Linden, N. J.
Williams, J. H. & Co., 400 Vulcan St., Buffalo, 7, N. Y.

BOOKS, Technical
Industrial Press, 93 Worth St., New York 13, N. Y.

BORING BARS
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.
Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
DeVlieg Microbore Div., 2720 W. Fourteen Mile Road, Royal Oak, Mich.
Ingersoll Milling Mch. Co., 2442 Douglas St., Rockford, Ill.
Kennametal Inc., Latrobe, Penna.
Metallurgical Products Dept. of General Electric Co., Box 327, Roosevelt Park Annex, Detroit 32, Mich.
Universal Engineering Co., Frankenmuth 2, Mich.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

BORING HEADS
American Schiess Corp., 1232 Penn Ave., Pittsburgh 22, Pa.
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
Bridgeport Machines, Inc., 500 Lindley St., Bridgeport 6, Conn.
Bryant Chucking Grinder Co., Clinton St., Springfield, Vt.
Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
DeVlieg Microbore Div., 2720 W. Fourteen Mile Road, Royal Oak, Mich.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Ingersoll Milling Mch. Co., 2442 Douglas St., Rockford, Ill.
Mummert-Dixon Co., Hanover, Pa.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio.
Universal Engineering Co., Frankenmuth 2, Mich.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

BORING MACHINES
Baker Bros. Inc., 1000 Post Ave., Toledo 10, Ohio
Buhr, Machine Tool Co., 839 Greene St., Ann Arbor, Mich.
Bullard Co., Bridgeport 6, Conn.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Davis & Thompson Co., 4460 N. 24th St., Milwaukee 10, Wis.
DeVlieg Machine Co., Fair St., Royal Oak, Mich.
Drillmation Co., Inc., Centerline, Mich.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gray Co., G. A., 3611 Woodburn Ave., Cincinnati 7, Ohio
Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.

(Continued on page 218)

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Jones & Lamson Machine Co., Springfield, Vt.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Moline Tool Co., Moline, Ill.
National Automatic Tool Co., Inc., S. 7th and N. Sts., Richmond, Ind.
Olivetti Corp. of America, 42-33 Northern Blvd., Long Island City 1, N. Y.
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
Olofsson Corp., Lansing, Mich.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheffield Corp., Box 893 Dayton 1, Ohio
Snyder Corp., 3400 E. Lafayette Ave., Detroit 7, Mich.
Wales-Strippit, Inc., Akron, N. Y.

BORING MILLS, Horizontal
American Schiess Corp., 1232 Penn Ave., Pittsburgh 22, Pa.
Bullard Co., Bridgeport 6, Conn.
Cincinnati Gilbert Machine Tool Co., 3366 Beekman St., Cincinnati 23, Ohio.
Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
DeVlieg Machine Co., Fair St., Royal Oak, Mich.
Espen-Lucas Machine Works, Front St. and Girard Ave., Philadelphia, Pa.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Gray, G. A., Co., 3611 Woodburn Ave., Cincinnati 7, Ohio.
Lucas Mch. Tool Div., New Britain Mch. Co. 12302 Kirby Ave., Cleveland 8, Ohio.
New Britain Mch. Co., New Britain, Conn.
Snyder Corp., 3400 E. Lafayette Ave., Detroit 7, Mich.

BORING MILLS, Vertical
American Schiess Corp., 1232 Penn Ave., Pittsburgh 22, Pa.
Berthiez, Charles, 5 Rue Montalivet, Paris France
Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.
Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Cosa Corp, 405 Lexington Ave., New York 17, N. Y.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
King Machine Tool Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio.
New Britain Mch. Co., New Britain, Conn.
Snyder Corp., 3400 E. Lafayette Ave., Detroit 7, Mich.

BORING TOOLS
American Schiess Corp., 1232 Penn Ave., Pittsburgh 22, Pa.
Armstrong Bros. Tool Co., 5213 W. Armstrong Ave., Chicago 46, Ill.
Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.
Davis Boring Tool Div., Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
DeVlieg Microbore Div., 2720 W. Fourteen Mile Road, Royal Oak, Mich.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Maxwell Industries, Inc., Ashtabula, Ohio
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

BRAKES, Press and Bending
Cincinnati Shaper Co., P. O. Box 111, Cincinnati 11, Ohio.
Cleveland Crane & Engrg. Co., Wickliffe, Ohio.
Ferracute Machine Co., Bridgeport, N. J.
Lodge & Shipley Co., Hamilton 1, Ohio.
Niagara Mch. & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 93rd St. and S. Kenwood Ave., Chicago, Ill.

BRASS
American Brass Co., 25 Broadway, New York N. Y.
Mueller Brass Co., Port Huron 35, Mich.
Revere Copper & Brass, Inc., 230 Park Ave., New York, N. Y.

BROACHES
du Mont Corp., Greenfield, Mass.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

BROACHING MACHINES, Internal
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.
Wilson, K. R., Inc., 211 Mill St., Arcade, N. Y.

BROACHING MACHINES, Surface
Cincinnati Milling & Grinding Mchs., Inc., Cincinnati, Ohio.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.

BRONZE
American Brass Co., Waterbury 20, Conn.
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250,000 Power Tools per year with Cities Service Pacemaker T

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But Cities Service Pacemaker T is more than a hydraulic oil . . . it is a multi-purpose line of lubricants suited for many applications. Porter-Cable also uses Pacemaker 300 T for lubricating valves in the plant's compressors. Pacemaker T can be used to lubricate bearings, diesel engines, electric motors, generators, reduction gear drives, turbines and in circulating systems.

Pacemaker T is available in various viscosities to give you one line of quality lubricants that can save costly warehouse space by simplifying your inventory . . . cut maintenance costs and extend equipment life. These oils have high viscosity index, excellent heat resistant properties and are chemically fortified against oxidation, corrosion, rust formation and foaming.

Contact your nearest Cities Service office and an experienced Lubrication Engineer will call to make specific recommendations for your plant on the use of Pacemaker T. Or for further information, write: Cities Service Oil Company, Sixty Wall Tower, New York 5, N. Y.

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QUALITY PETROLEUM PRODUCTS

Porter-Cable Machine Company
Syracuse, New York

Porter-Cable Research Engineer testing engine for new lawnmower the company will produce soon. All new products undergo extensive research and testing before production.

Backbone of Production Line is Automatic Screw Machine. Pacemaker T gives outstanding performance as hydraulic medium in these machines as well as in Landis grinders and as a general lubricant!

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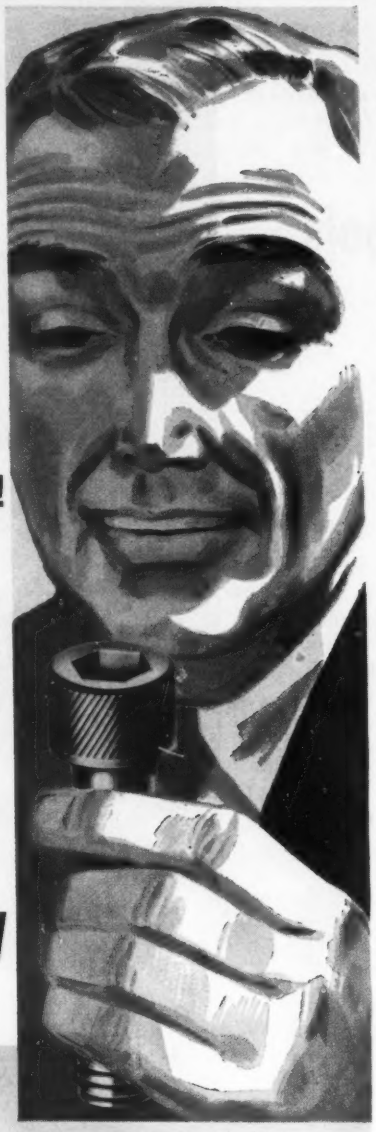
XUM

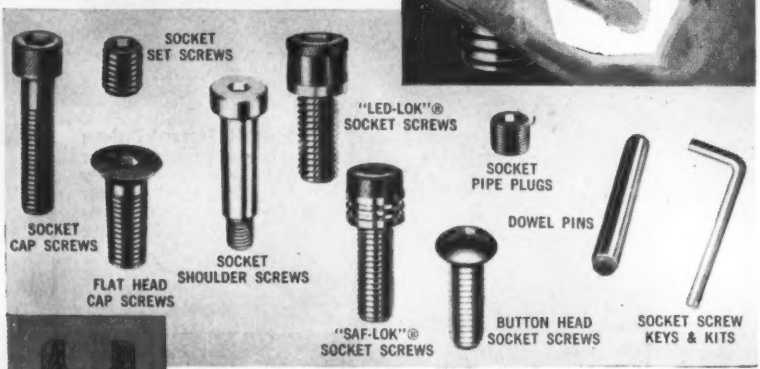
HOW TO GET A "thread-start" ON PRODUCTION!



The diagonal knurled head on all Blue Devil Socket Cap Screws gives you a "non-slip" grip that eliminates the danger of fumbling during assembly. It's typical of the quality, design and manufacture you'll find in all

Blue Devil®

SOCKET SCREW PRODUCTS



Actual cross-section diagram shows how cold forming of Blue Devil Socket head insures unimpaired fiber continuity.

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Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

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Birdsboro, Steel Foundry & Machine Co., Birdsboro, Pa.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio.
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Wood, R. D., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

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Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.

BURRING MACHINES—See Deburring Machines

BURRS—See Files and Burrs, Rotary

BUSHINGS, Drill Jig
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Metal Carbides Corp., 6001 Southern Blvd., Youngstown 12, Ohio.
Universal Engrg. Co., Frankenmuth, Mich.

BUSHINGS, Hardened Steel
Universal Engrg. Co., Frankenmuth, Mich.

BUSHINGS, Non-ferrous and Powdered Metal
Bunting Brass & Bronze Co., 715 Spencer, Toledo Ohio.
Universal Engrg. Co., Frankenmuth, Mich.

CALIPERS, Spring, Firm-Joint, Transfer, Hermaphrodite, etc.—See Layout and Drafting Tools, Machinists' Small Tools

CALIPERS, Vernier
Brown & Sharpe Mfg. Co., Providence, R. I.
DoAll Co., Des Plaines, Ill.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.

CAM CUTTING MACHINES
Cincinnati Milling & Grinding Mchs., Inc., Cincinnati 9, Ohio.
Cosa Corp., 405 Lexington Ave., New York, 17, N. Y.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

CAMERAS, High Speed
Wollensak Optical Co., Rochester 21, N. Y.

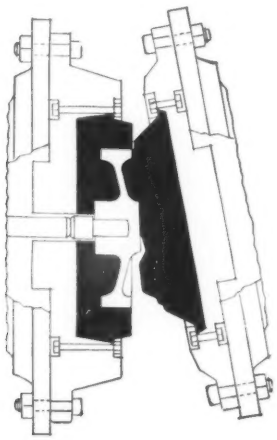
CAM MILLING AND GRINDING MACHINES
American Schiess Corp., 1232 Penn Ave., Pittsburgh 22, Pa.
Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
Cincinnati Milling Machine Co., Oakley, Cincinnati, Ohio.
Landis Tool Co., Waynesboro, Pa.
Rowbottom Machine Co., Waterbury, Conn.

CAMS
Brown & Sharpe Mfg. Co., Providence, R. I.
Eisler Engrg. Co., Inc., 750 S. 13th, Newark 3, N. J.
Rowbottom Machine Co., Waterbury, Conn.

Unique Mill Forges and Rolls circular products in one operation

In less than one minute, this Bethlehem mill—the only one of its kind in the country —turns out a top-quality impression-die steel forging at a cost that's hard to match.

This is Bethlehem's famed circular-products mill—the Slick Mill. Named for its designer, Edwin E. Slick, this unique machine produces impression-die circular forgings ranging from 10 in. to 46 in. OD; as-rolled weights ranging from 100 to 2,000 lb. It handles almost any grade of steel—carbon, alloy or stainless, as well as certain heat-resistant grades.

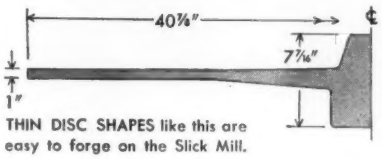


How It Works

Designed to operate in a horizontal plane, Bethlehem's Slick Mill is constructed with two *revolvable* spindles on which face plates are mounted. These face plates support the impression dies that form the steel billet into shape by a combination press and rolling action.

After the steel billet is heated and descaled, it is centered between the dies of the Slick Mill. Then a 1500-ton hydraulic ram actuates the spindle on the straight side of the mill, upset forging the billet. When this cycle is completed, a 2,000-hp motor actuates the spindle on the angle side of the mill and the rolling cycle begins. By continuing the upsetting action and rotation of the dies and work, the material flows into the recesses of the dies, resulting in the desired shape. *The entire rolling cycle takes about one minute.*

After rolling, excess material in the form of flash is sheared off; the hub, when necessary, is punched; and the forging is inspected.



THIN DISC SHAPES like this are easy to forge on the Slick Mill.

Cost-Saving Features

Quick operation: Only one minute is needed to convert a heated slug into a contoured forging, whether the product weighs 100 or 2,000 lb.

Quick die changes: Only 15 minutes are needed to change and set up dies. Even production runs as small as 25 or 50 pieces are economical.

Low die charges: Since contact time between die and work is very brief, and because there is no impacting, low-cost die blocks can be used. In many cases, die charges are ⅓ to ½ less than conventional impression dies.

Less steel needed: Utilizing the principle of forging design, the Slick Mill can produce lighter-weight sections without sacrificing strength.

Good physical characteristics: The process insures excellent grain flow, machinability and soundness.

Bethlehem's Slick Mill is readily adapted to jobbing or production quantities of forged circular products such as: gear blanks, fly wheels; crane track wheels; sheave wheels; brake drums; clutch discs; couplings; tire moulds; and turbine or compressor wheels. Products may be specified as-rolled or rough machined to specifications.

Your inquiry—whatever the quantity involved—will receive prompt attention. Call or write the Bethlehem sales office nearest you today.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

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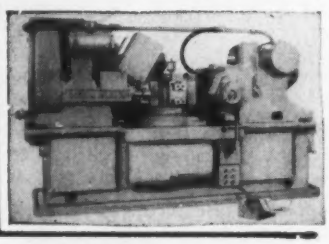
Single set-up covering ALL finishing operations...

MEANS GREATER ACCURACY with GOSS DeLEEUW

AUTOMATIC CHUCKING MACHINES

One of the many important advantages being realized with this new chucker is the performing of ALL finishing operations on a single chucking of the work. In addition to the time saved, this feature, exclusive with Goss & De Leeuw "1-2-3" machines, means only one handling of the work with an attendant greater accuracy. This machine is in a class by itself in precision finishing.

In Goss & De Leeuw "1-2-3" Automatic Chucking Machines, one, two, or three ends of the work are machined simultaneously or in sequence. There is no need for resetting, retooling or secondary operations. More work from one machine and greater accuracy are matters of record.



Ask for illustrated literature describing the operation of this chucker in detail. Send samples of your work for time and cost estimates.

GOSS & DeLEEUW QUALITY PRODUCT-QUANTITY

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DoALL Co., Des Plaines, Ill.
Kennametal, Inc., Latrobe, Penna.
Linde Co., 30 E. 42nd St., New York 17, N. Y.
Metal Carbides Corp., Youngstown, Ohio.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd, Detroit 20, Mich.

CASTINGS, Die
American Brass Co., Waterbury 20, Conn.
Madison-Kipp Corp., Madison, Wis.

CASTINGS, Non-ferrous
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Mueller Brass Co., Port Huron 35, Mich.
Shenango Furnace Co., Dover, Ohio.
Textile Machine Works, Reading, Penna.
Vascoloy-Ramet Corp., Waukegan, Ill.

CASTINGS—Gray Iron, Malleable
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio.
Kaukauna Machine & Foundry Div., Giddings & Lewis Machine Tool Co., Kaukauna, Wis.
Malleable Castings Council, 1800 Union Commerce Bldg., Cleveland 14, Ohio.
Shenango Furnace Co., Dover, Ohio.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Textile Machine Works, Reading, Penna.

CASTINGS, Steel, Stainless, etc.
Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Birdsboro Steel Fdry. & Mch. Co., Birdsboro, Pa.
Jessop Steel Co., Washington, Penna.

CENTER-DRILLING MACHINES
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

CENTER PUNCHES—See Machinists' Small Tools

CENTERS, Grinding Machines, Indexing Head and Lathe
DoAll Co., Des Plaines, Ill.
Metal Carbides Corp., Youngstown, Ohio.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit, Mich.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

CERAMIC TOOL MATERIAL—See Tool Material, Ceramic

CHAINS, Power Transmission and Conveyor
Boston Gear Works, 14 Hayward St., Quincy 71, Mass.

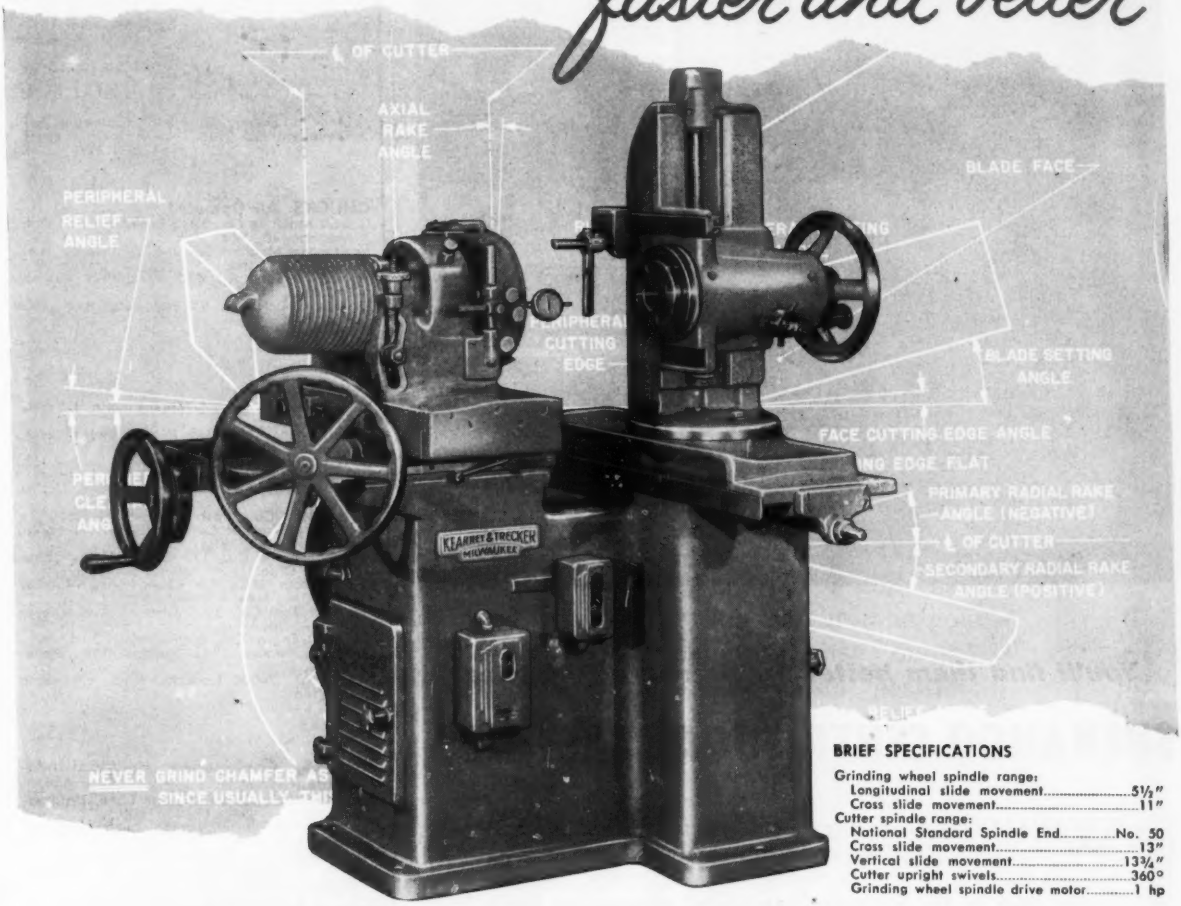
CHUCKING MACHINES, Multiple-Spindle Automatic
Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Goss & DeLeeuw Mch. Co., Kensington, Conn.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.

(Continued on page 224)

ESPECIALLY DESIGNED TO...

SHARPEN CARBIDE FACE MILL CUTTERS

faster and better



BRIEF SPECIFICATIONS

Grinding wheel spindle range:	
Longitudinal slide movement	5½"
Cross slide movement	11"
Cutter spindle range:	
National Standard Spindle End	No. 50
Cross slide movement	13"
Vertical slide movement	13¾"
Cutter upright swivels	360°
Grinding wheel spindle drive motor	1 hp

KEARNEY & TRECKER MILWAUKEE

FACE MILL

CUTTER GRINDERS

handle all types of face mill cutters up to 24" in diameter. Accurate to 0.0002"

EVERY important feature you need for low-cost, efficient sharpening of carbide and H.S.S. face mill cutters is built into these Kearney & Trecker heavy-duty precision Cutter Grinders.

Handily located controls simplify operation. Graduated dials facilitate setups. Spindle flywheel helps maintain 3400 rpm constant speed during grinding. A jeweled-bearing dial indicator is furnished for checking finished cutter accuracy.

Three-inch to 7" dia. face mills attach to style "C" arbors and mount on the cutter spindle head. Cutters 8" to 24" dia. bolt directly to spindle nose.

Write for Bulletin G-10, Kearney & Trecker Corp., 6788 W. National Avenue, Milwaukee 14, Wisconsin.

KEARNEY & TRECKER MILWAUKEE

Designers and Builders of Precision and Production Machine Tools Since 1898

For more data, circle this page number on inquiry card

XUM

You'll find them better for pressure if they're

SHENANGO CENTRIFUGAL CASTINGS

WHATEVER the inside or outside pressures, Shenango centrifugal castings are better able to withstand them without failure.

Parts cast by the Shenango centrifugal process are much tougher because their finer, *pressure-dense* grain avoids stress concentrations while providing greater strength, better elongation and freedom from such costly defects as sand inclusions, blowholes and such.

Whether you need rings, rolls, sleeves, liners, bushings, bearings, mandrels or *any* annular or symmetrical part . . . ferrous or non-ferrous . . . in whatever shape, size or dimension to meet your requirements . . . Shenango can do the job. And do the job *better!*

For informative bulletins on the answers to your tough problems, it will pay you to write now to: *Centrifugally Cast Products Division,* The Shenango Furnace Company, Dover, O.

SHENANGO CENTRIFUGAL CASTINGS

COPPER, TIN, LEAD, ZINC BRONZES • ALUMINUM AND MANGANESE BRONZES
MONEL METAL • NI-RESIST • MEEHANITE METAL • ALLOY IRONS

C

Olotsson Corp., 2729 Lyons Ave., Lansing, Mich.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio.

CHUCKING MACHINES, Single-Spindle Automatic
Bullard Co., 286 Canfield Ave., Bridgeport 6, Conn.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Jones & Lamson Mch. Co., Springfield, Vt.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
Potter & Johnston Co., 1027 Newport Ave., Pawtucket, R. I.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 83, Ohio.

CHUCKS, Air Operated
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Logansport Machine Co., Inc., 810 Center Ave., Logansport, Ind.
Schrader's Son, A., 470 Vanderbilt Avenue, Brooklyn, N. Y.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Collet
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Gisholt Mch. Co., 1245 E. Washington Ave., Madison 10, Wis.
Gorton Mch. Co., Geo., 1321 Racine St., Racine, Wis.
Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
Jacobs Mfg. Co., West Hartford 10, Conn.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio.
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
Standard Tool Co., 3950 Chester Ave., Cleveland 14, Ohio.
Universal Engrg. Co., Frankenmuth 2, Mich.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio.
Zagar, Inc., 24000 Lakeland Blvd., Cleveland 23, Ohio.

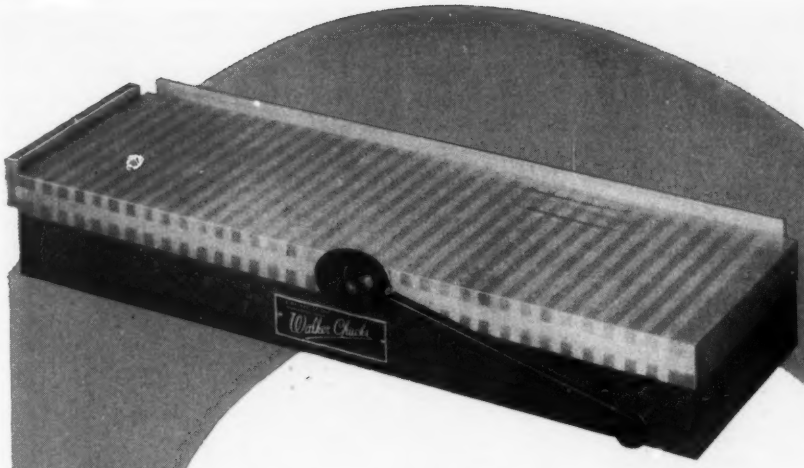
CHUCKS, Combination Universal-Independent
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Geometric-Horton Div., United Greenfield Corp., New Haven, Conn.
Gisholt Mch. Co., Madison, 10, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
L-W Chuck Co., Toledo 4, Ohio
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Compensating
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Diaphragm
Woodworth, N. A. Co., 1300 E. Nine Mile Rd., Detroit 20, Mich.

CHUCKS, Drill, Key Type
Jacobs Mfg. Co., West Hartford, Conn.

CHUCKS, Drill, Keyless
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37 N. Y.
Jacobs Mfg. Co., West Hartford, Conn.



Finest, **Most Complete Line of Permanent Magnetic Chucks***

O. S. Walker offers the world's finest chucks – both rectangular and rotary – in a full range of sizes. Their magnets are the most permanent magnets ever produced! They're ceramic, with many times the coercive force of alloy magnets. The face of every chuck is *all steel* (no soft insulating material). Other important features: 50% less weight; low, low height; fine pole divisions for maximum holding power; easy "on-off" lever, with complete demagnetization in "off" position. Write for catalog.

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O.S. WALKER COMPANY, INC.
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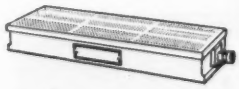
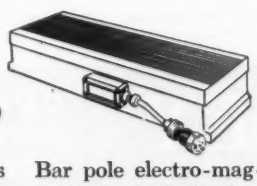
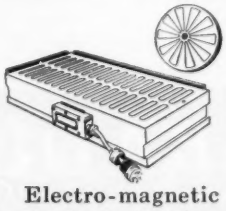
O. S. Walker – The Original Designers and Builders of Magnetic Chucks!



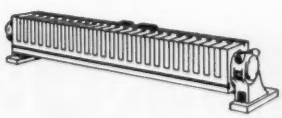
Special vacuum chucks for holding non-ferrous parts



Bar pole electro-magnetic chucks in 81 sizes



Electro-magnetic chucks in 172 sizes



Special electro and magnetic chucks and magnetic holding fixtures

Standard and special demagnetizers

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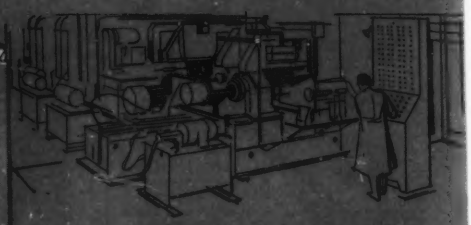
AUTOMATION BEGINS HERE

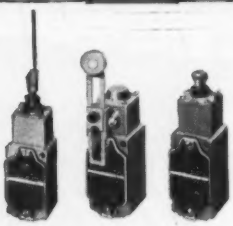
. . . Insist on Allen-Bradley accessories for continuous automatic production



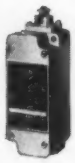
In this broad line of Allen-Bradley accessories, each and every unit carries the traditional A-B trademark of *quality* that stands for trouble free operation. Rugged construction, and maintenance free, silver alloy contacts provide the reliability that is essential to the continuous operation of *your* automatic production machines.

Profit from the experience of the leading machine tool builders . . . insist on Allen-Bradley *quality* motor control *all the way!*

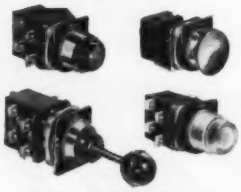
Special push button panels can be assembled to your specifications.



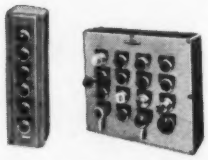
OILTIGHT LIMIT SWITCH
Bulletin 802T with sealed heads and bodies. Various operators.



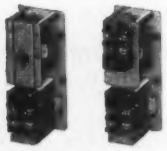
PRECISION LIMIT SWITCH
Bulletin 802 oiltight. Responds to very small operator travel.



OILTIGHT CONTROL UNITS
Bulletin 800T. Choice of push buttons, lights, and switches.

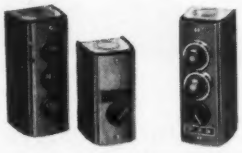


OILTIGHT CONTROL STATIONS
Bulletin 800T for up to 16 units in die cast aluminum enclosure.

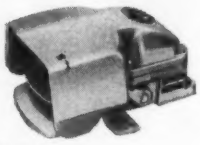


PNEUMATIC TIMERS
Bulletin 849. Reliable and accurate. For on-delay or off-delay.

OILTIGHT PRESSURE CONTROL
Bulletin 836. For hydraulic systems with pressures to 5000 psi.



STANDARD DUTY PUSH BUTTONS
Bulletin 800. Up to three units, also pilot lights and switches.



FOOT SWITCH
Bulletin 805. In rugged die cast housing for toughest service.

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Member of NEMA

QUALITY MOTOR CONTROL

Allen-Bradley Co., 1331 S. First St., Milwaukee 4, Wis. In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

CHUCKS, Full Floating
Gisholt Mch. Co., Madison 10, Wis
Scully-Jones & Co., 1903 Rockwell St., Chicago 8, Ill.
Universal Engineering Co., Frankenmuth 2, Mich.

CHUCKS, Gear
Buck Tool Co., 2015 Schippers Lane, Kalamazoo Mich.
Geometric-Horton Div., United Greenfield Corp., New Haven, Conn.
Le Maire Machine Tool Co., 2657 S. Telegraph Rd., Dearborn, Mich.

CHUCKS, Independent
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Geometric-Horton Div., United Greenfield Corp., New Haven, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Lathe
Bullard Co., Brewster St., Bridgeport 2, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Jacobs Mfg. Co., West Hartford, Conn.
Jones & Lamson Mch. Co., Springfield, Vt.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.
Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio.

CHUCKS, Magnetic
Brown & Sharpe Mfg. Co., Providence, R. I.
Hanchett Magna-Lock Corp., Big Rapids, Mich.
L-W Chuck Co., Toledo 4, Ohio.
Sundstrand Mch. Tool Co., 2531—11th St., Rockford, Ill.
Walker, O. S. Inc., Worcester, Mass.

CHUCKS, Power Operated
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Gisholt Mch. Co., Madison 10, Wis.
Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.

CHUCKS, Quick Change and Safety
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Jacobs Mfg. Co., West Hartford 10, Conn.
Universal Engineering Co., Frankenmuth 2, Mich.

CHUCKS, Ring Wheel
Gardner Mch. Co., 414 E. Gardner St., Beloit, Wis.

CHUCKS, Tapping
Jacobs Mfg. Co., West Hartford, Conn.
Scully-Jones & Co., 1903 Rockwell St., Chicago 8, Ill.

CHUCKS, Universal Three-Jaw
Buck Tool Co., 2015 Schippers Lane, Kalamazoo, Mich.
Geometric-Horton Div., United Greenfield Corp., New Haven, Conn.
Gisholt Mch. Co., Madison 10, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
L-W Chuck Co., Toledo 4, Ohio
Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.
Warner & Swasey, 5701 Carnegie Ave., Cleveland 3, Ohio.

CHUCKS, Wrenchless
Gisholt Mch. Co., Madison 10, Wis.

CLAMPS, "C", Toggle, Toolmakers' Parallel—See Set-Up Equipment

CLEANERS, Metal
Houghton, E. F. & Co., 303 W. Lehigh Ave., Philadelphia 33, Penna.
Oakite Products, Inc., 26 Rector St., New York, N. Y.

CLUTCHES
Cleveland Punch & Shear Works Co., 3817 St. Clair Ave., Cleveland 14, Ohio.
Conway Clutch Co., 2747 Colerain Ave., Cincinnati 25, Ohio.
Minster Mch. Co., Minster, Ohio.

COLD HEADING
National Machinery Co., Tiffin, Ohio.
Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.

COLLETS—See Chucks, Collet

COMBINATION SQUARES—See Machinists' Small Tools

COMPARATORS, Dial, Electronic and Air
DoALL Co., Des Plaines, Ill.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Sheffield Corp., Box 883, Dayton 1, Ohio.

COMPARATORS, Optical
DoALL Co., Des Plaines, Ill.
Eastman Kodak Co., Rochester, N. Y.
Jones & Lamson Mch. Co., Springfield, Vt.
Opto-Metric Tools, Inc., 137 Varick St., New York 13, N. Y.
Scherr, George, Co., Inc., 200 Lafayette St., New York 12, N. Y.

COMPOUNDS, Cleaning—See Cleaners, Metal

COMPOUNDS, Cuttings, Grinding, Metal Drawing, etc.—See Cutting and Grinding Fluids

COMPRESSORS, Air
Chicago Pneumatic Tool Co., New York 17, N. Y.

CONTOUR FOLLOWER—See Tracing Attachments

CONTRACT WORK
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio.
Eisler Engrg. Co., 750 S. 13th St., Newark 3, N. J.
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
Textile Machine Works, Reading, Penna.
Van Keuren Co., 176 Waltham St., Watertown 72, Mass.

CONTROLLERS
Allen-Bradley Co., 1331 S. 1st St., Milwaukee, Wis.

CONTROL SHAFTS—See Lead-screws & Splines, Ball Bearing

CONVEYORS FOR DUST, CHIPS, ETC.
Barnes, W. F. & John Co., Rockford, Ill.

COPPER
American Brass Co., 25 Broadway, New York, N. Y.
Mueller Brass Co., Port Huron 35, Mich.
Revere Copper & Brass Inc., 230 Park Ave., New York, N. Y.

COUNTERBORES AND COUNTERSINKS
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Circular Tool Co., Inc., 765 Allens Ave., Providence 5, R. I.
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland, Ohio.
Cogsdill Twist Drill Co., Greenfield, Mass.
DoALL Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Mohawk Tools, Inc., Montpelier, Ohio.
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.
Wesson Co., 1200 Woodward Heights Blvd., Detroit 20, Mich.

COUNTERS
Starrett, The L. S., Co., Athol, Mass.

COUPLINGS
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Boston Gear Works, 14 Hayward St., Quincy 71, Mass.
James, D. O., Gear Mfg. Co., 1140 W. Monroe St., Chicago 7, Ill.
Mueller Brass Co., Port Huron, Mich.
Schrader's Sons, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.
Walker Co., Inc., O. S., Rockdale St., Worcester, Mass.

CRANES, Electric Traveling
Cleveland Crane & Engrg. Co., Wickliffe, Ohio.

CUTTERS, Keyseating
Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio.
DoALL Co., Des Plaines, Ill.
Mitts & Merrill, 1009 So. Water St., Saginaw, Mich.

CUTTERS, Milling
Barber-Colman Co., 1300 Rock St., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill (end mills).
Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland, Ohio.
DoALL Co., Des Plaines, Ill.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Gorton, George, Mch. Co., 1321 Racine St., Racine, Wis.
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Kennametal, Inc., Latrobe, Penna.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Motch & Merryweather Mchy. Co., 888 E. 70th St., Cleveland 3, Ohio.
Tomkins-Johnson Co., Jackson, Mich.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

CUTTING AND GRINDING FLUIDS
Cincinnati Milling Products Div., Cincinnati, Ohio.
Cities Service Oil Co., 70 Pine St., New York, N. Y.
Houghton, E. F. & Co., 303 W. Lehigh Ave., Philadelphia 33, Penna.
Oakite Products, Inc., 26 Rector St., New York 6, N. Y.
Shell Oil Co., 50 W. 50th St., New York, N. Y.
Sinclair Refining Co., 600 Fifth Ave., New York, N. Y.
Stuart, D. A. Oil Co., Ltd., 2727 S. Troy St., Chicago 23, Ill.
Texaco, Inc., 135 E. 42nd St. New York 17 N. Y.

CUTTING-OFF MACHINES, Lathe Type
Bardons & Oliver, Inc., 1133 W. Ninth St., Cleveland 13, Ohio.
Brown & Sharpe Mfg. Co., Providence, R. I.
Modern Machine Tool Co., Jackson, Mich.

IT HAS QUALITIES YOU WANT !

Bunting
Alcoa Aluminum Bars

BUNTING AL2028 ALCOA 3½ x 2½
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BUNTING AL1320 ALCOA 2¼ x 1¾
BUNTING ALS16 ALCOA 2
BUNTING AL1216 ALCOA 2 x 1½
BUNTING ALS12 ALCOA 1½
BUNTING AL711 ALCOA 1¾

BUNTING BEARING ALUMINUM offers improved quality over low priced Bronze Bars and at a comparable price. It possesses the important qualities which make a good sleeve bearing material, namely:

- Good heat conductivity
- Excellent embedability
- Good ductility
- High load-carrying capacity
- High resistance to corrosion
- Conformability to the shaft
- Good fatigue strength

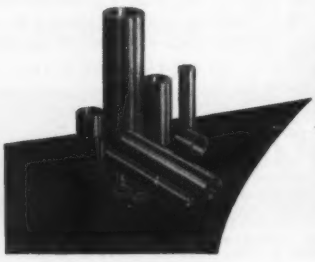
Your Bunting distributor now has in stock 138 sizes of 13" tubular and solid Bunting Bearing Aluminum Bars. Write or ask for catalog and literature.

Other Products Available from Your Bunting Distributor

866 stock sizes of Bunting Cast Bronze Bearings and 267 sizes of Bunting Cast Bronze 13" Bars. 667 sizes of Bunting Sintered Oil-filled Bronze Plain, Flange and Thrust bearings and 84 sizes of Sintered Bronze 6½" Bars. Ask for Catalog 58.

343 sizes of Bunting Cast Bronze Electric Motor Bearings for all motors. Ask for Catalog 258.

ask him . . .
Your Bunting distributor is listed in the classified section of your telephone directory usually under Bars — Bronze and Bearings — Bronze.



Bunting.

BEARINGS, BUSHINGS, BARS AND SPECIAL PARTS OF CAST BRONZE OR SINTERED METALS. ALCOA® ALUMINUM BARS.

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Johnson Manufacturing Co., Albion, Mich.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Simonds Abrasive Co., Tacony & Fraley Sts., Philadelphia 35, Penna.
Ty-Sa-Man Machine Co., Inc., 1093 White Ave., Knoxville, Tenn.
Wallace Supplies Mfg. Co., 1310 W. Diversey Parkway, Chicago 14, Ill.

CUTTING TOOLS—See Tool Materials

CYLINDERS, Air
Hannifin Co.,., Div. Parker-Hannifin Corp., Des Plaines, Ill.
Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.
Logansport Mch. Co., Inc., Logansport, Ind.
Skinner Chuck Co., 95 Edgewood Ave., New Britain, Conn.
Tomkins-Johnson Co., Jackson, Mich.

CYLINDERS, Hydraulic
Barnes, John S., Corp., 301 S. Water St., Rockford, Ill.
Chicago Pneumatic Tool Co., New York 17, N. Y.
Hannifin Co.,., Div. Parker-Hannifin Corp., Des Plaines, Ill.
Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.
Logansport Machine Co., Inc., Logansport, Ind.
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Vickers Inc., Administrative & Engineering Center, Box 302, Detroit 32, Mich.

DEBURRING MACHINES
Barber-Colman Co., 1300 Rock St. Rockford, Illinois
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
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Sheffield Corp., Box 893, Dayton 1, Ohio.
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Hydraulic Press Mfg. Co., Mount Gilead, Ohio.

DIE CUSHIONS
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio.
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Danly Machine Specialties, Inc., 2100 South Laramie, Chicago 50, Ill.
Minster Machine Co., Minster, Ohio.
Verson Allsteel Press Co., 93rd St., and S. Kenwood Ave., Chicago, Ill.

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Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Kennametal, Inc., Latrobe, Penna.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Vascoloy-Ramet Corp., Waukegan, Ill.

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Cratex Mfg. Co., Inc., Burlingame, Calif.
Danly Machine Specialties, Inc., 2100 South Laramie, Chicago 50, Ill.
Lempco Industrial, Inc., Bedford, Ohio.
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U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.
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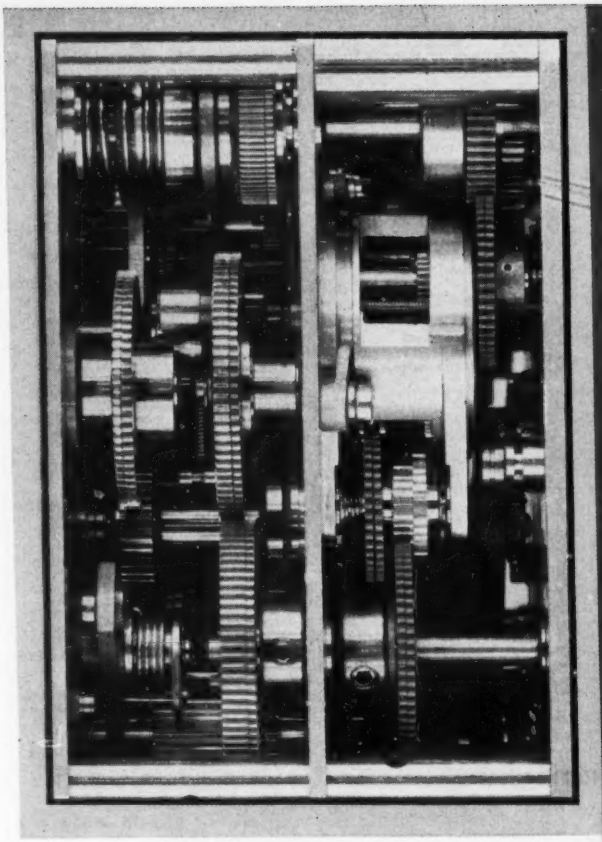
DIE STOCKS—See Stocks and Dies



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Niagara Mch. & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Olofsson Corp., Lansing, Mich.
Ryerson & Son, Inc., Jos. T., 16th & Rockwell St., Chicago 8, Ill.
Vascoloy-Ramet Corp., Waukegan, Ill.
Verson Allsteel Press Co., 93rd St., and S. Kenwood Ave, Chicago, Ill.
Wales-Strippit, Inc., Akron, N. Y.

DIES, Lettering and Embossing
Wales-Strippit, Inc., Akron, N. Y.

DIES, Self-opening Threading
Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Greenfield Tap & Die Corp., Greenfield, Mass.
Jones & Lamson Mch Co., Springfield, Vt.
Landis Mch Co., Waynesboro, Pa.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.

DIES, Thread Cutting—See Stocks and Dies

DIES, Thread Rolling
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National Acme Co., 170 E. 131st St., Cleveland, Ohio.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Reed Rolled Thread Die Co., P. O. Box 350, Worcester 1, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio.

DIE STEELS
Jessop Steel Co., Washington, Penna.

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Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Elox Corp. of Michigan, Troy, Mich.

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DIVIDING HEADS—See Indexing and Spacing Equipment

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Norton Co., 1 New Bond St., Worcester, Mass.
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DoALL Co., Des Plaines, Ill.

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Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
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Jarvis Corp., Middletown, Conn.
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Snyder Corp., 3400 E. Fafayette Ave., Detroit 7, Mich.
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DRILLING ATTACHMENTS, Multiple Spindle—See Drill Heads, Multiple Spindle, and Vises, Machine

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Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
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National Automatic Tool Co., S. 7th and N Sts., Richmond, Ind.
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Sheffield Corp., Box 893, Dayton 1, Ohio.
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Greenlee Bros. & Co., 136 12th St., Rockford, Ill.
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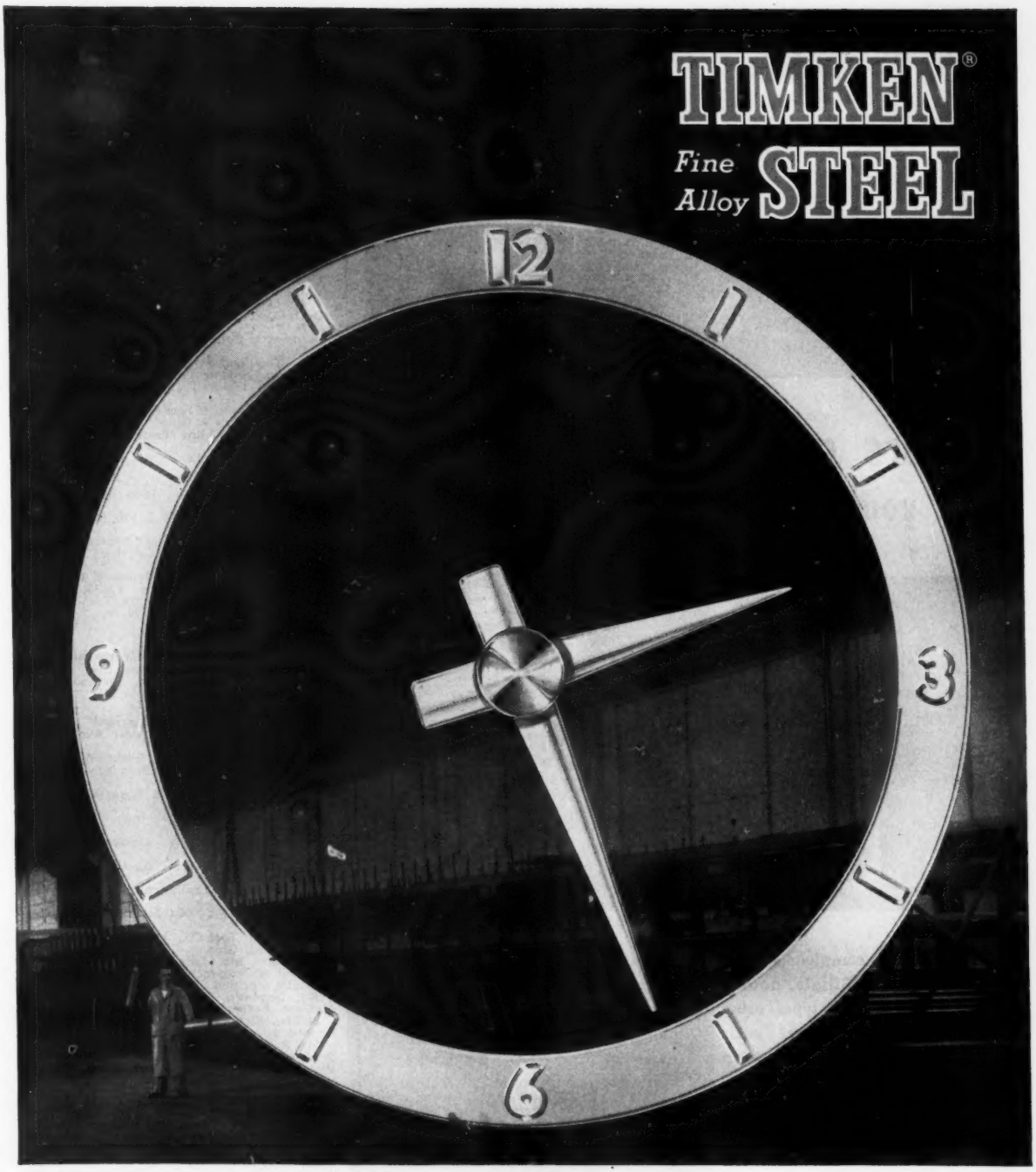

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Chicago Pneumatic Tool Co., New York 17 N. Y.

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Mohawk Tools, Inc., Montpelier, Ohio.

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Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

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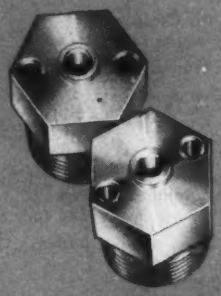
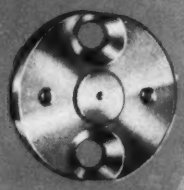
PRODUCTION:
Brass, 800/50 min. hour. Stainless, 175/50 min. hour.



PARTS:
Brass.

OPERATIONS:
Drill and countersink two holes, .173" dia. with .350", 82° countersink. Also drill and tap (#2-56) two holes.

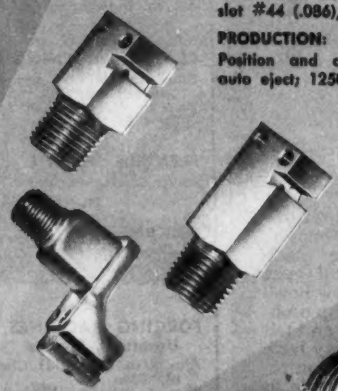
PRODUCTION:
1500/50 min. hour.

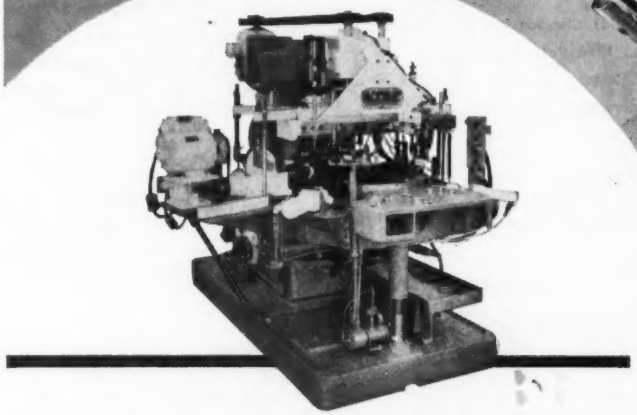


PARTS:
Forged brass gauge-sockets.

OPERATIONS:
An unusual feature is two-step drilling of two holes . . . first 1/2-way through, using #37 (.104") half-round drills with bushings; then drill through and chamfer in one operation, using combination half-round drills. By this method tolerances on hole centers are held to ± .001" on the entry and ± .003" on exit side after drilling through 9/16" of stock. Tap same two holes #6-32 9/32" deep. Mill slot .135" (± .002") wide x .156" deep with horizontal milling spindle and 4" saw-type cutter. Drill hole from bottom of milled slot #44 (.086), 5/16" deep.

PRODUCTION:
Position and clamp; auto unclamp and auto eject; 1250 pieces per 50 min. hour.





PART:
Stainless Steel (AISI 347).

OPERATIONS:
Drill, chamfer and tap (#2-56) two holes 3/16" deep.

PRODUCTION:
150/50 min. hour.

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FEEDERS, Automatic
Gear-O-Mation Div., Michigan Tool Co., 7171 McNichols Rd., Detroit 12, Mich.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.

FILES, Band
DoALL Co., Des Plaines, Ill.

FILES, General-purpose, Swiss Pattern
DoALL Co., Des Plaines, Ill.

FILES AND BURRS, Rotary
DoALL Co., Des Plaines, Ill.
Jarvis Corp., Middletown, Conn.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

FILING MACHINES
Chicago Pneumatic Tool Co., New York 17, N. Y.
DoALL Co., Des Plaines, Ill.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.

FILTERS, Coolant and Oil
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Cuno Engineering Corp., Meriden, Conn.
Johnson, S. C. & Son, Inc., Racine, Wis.
Marvel Engineering Co., 7227 N. Hamlin Ave., Chicago 45, Ill.

FLAME-HARDENING MACHINES
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.

FLEXIBLE SHAFT EQUIPMENT
Jarvis Corp., Middletown, Conn.

FORGING HAMMERS, Steam and Air
Chambersburg Engrg. Co., Chambersburg, Pa.
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.

FORGING MACHINES, Headers, Upsetters, Presses
Ajax Mfg. Co., 1441 Chardon Rd., Cleveland 17, Ohio
Bliss, E. W. Co., 1375 Raff Rd. S. W. Canton, Ohio
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
National Machinery Co., Tiffin, Ohio
Waterbury Farrel Foundry & Mch. Co., Waterbury, Conn.

FORGING, Hollow-Bored
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Mueller Brass Co., Port Huron 35, Mich.

FORGINGS, Drop
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Mueller Brass Co., Port Huron 35, Mich.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.
Wyman-Gordon Co., Worcester, Mass.

FORGINGS, Press
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Cleveland Punch & Shear Works Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Minster Mch. Co., Minster, Ohio
Mueller Brass Co., Port Huron 35, Mich.
Revere Copper & Brass Inc., 230 Park Ave., New York 17, N. Y. (die-pressed)
Vanadium-Alloys Steel Co., Latrobe, Penna.
Wyman-Gordon Co., Worcester, Mass.

FORGINGS, Upset
Bethlehem Steel Co., 701 East Third St., Bethlehem, Pa.
Vanadium-Alloys Steel Co., Latrobe, Penna.

FORMING MACHINES, Cold-Rolling
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Michigan Tool Co., Mount Gilead, Ohio
Detroit 12, Mich.
Niagara Mch. & Tool Works, 637 Northland Ave., Buffalo, N. Y.
Yoder Co., 5500 Walworth, Cleveland, Ohio

FORMING MACHINES, Multiple-slide
Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Brown & Sharpe Mfg. Co., Providence, R. I.
Chambersburg Engrg. Co., Chambersburg, Pa.
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
U. S. Tool Co., Inc., 255 North Main St., Ampere, E. Orange, N. J.

FORMING TOOLS or Tool Blanks
Brown & Sharpe Mfg. Co., Providence, R. I.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
Wesson Co., 1220 Woodward Heights Blvd., Ferndale, Mich.

GAGE BLOCKS
Brown & Sharpe Mfg. Co., Providence, R. I.
DoALL Co., Des Plaines, Ill.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

GAGES, Air Comparator
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio

GAGES, Automatic Sorting
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Sheffield Corp., Box 893, Dayton 1, Ohio

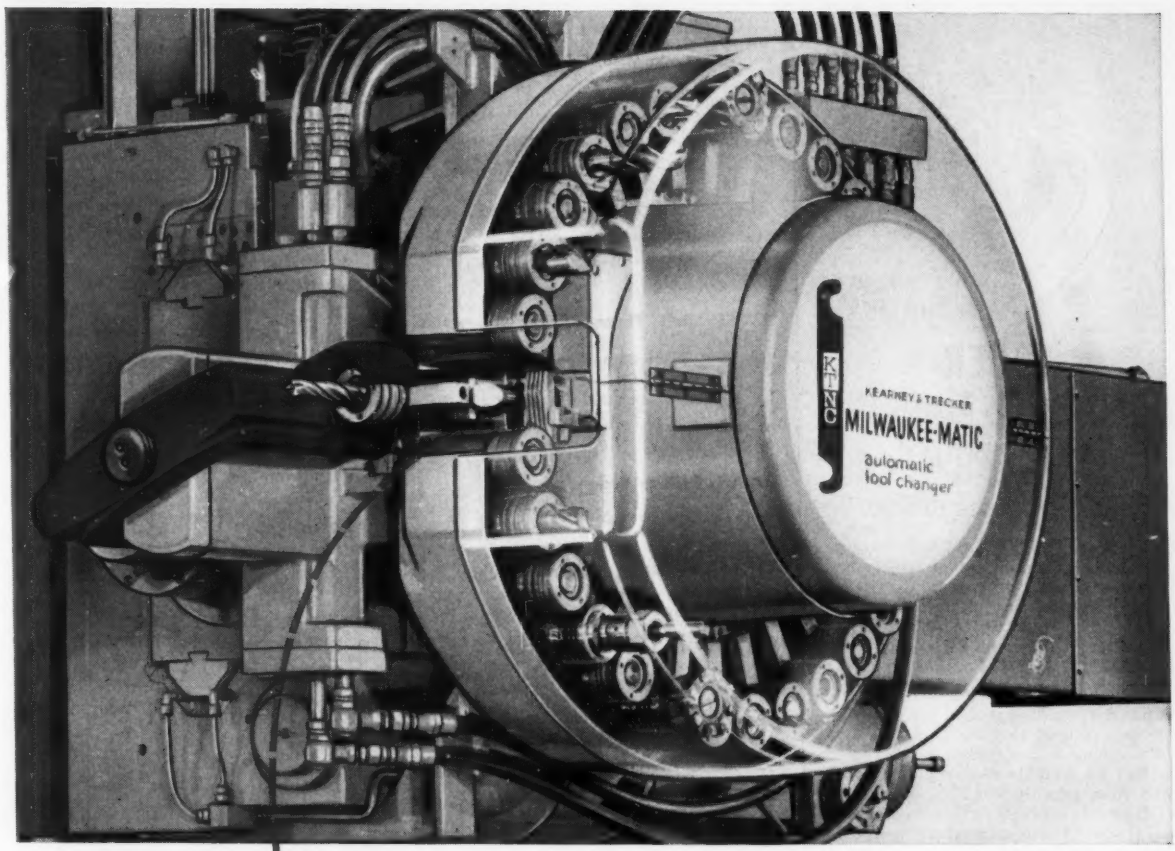
GAGES, DIAL, Bore, Height, Depth, Thread, Groove, etc.
Ames, B. C., Co., Waltham 54, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cadillac Gage Co., P. O. Box 3806, Detroit, Mich.
Comtor Co., 47 Farwell St., Waltham 54, Mass.
DoALL Co., Des Plaines, Ill.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

GAGES Electric Comparator
Brown & Sharpe Mfg. Co., Providence, R. I.
DoALL Co., Des Plaines, Ill.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Sheffield Corp., Box 893, Dayton 1, Ohio

GAGES, Grinding
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Sheffield Corp., Box 893, Dayton 1, Ohio

GAGES, Machinists' Hand, including Center, Cutter Clearance, Drill Point, Drill Size, Planer, Radius, Screw Pitch, Taper Telescoping Thickness
Brown & Sharpe Mfg. Co., Providence, R. I.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

GAGES, Multiple Inspection
Federal Products Corp., 1144 Eddy St., Providence 1, N. Y.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Sheffield Corp., Box 893, Dayton 1, Ohio



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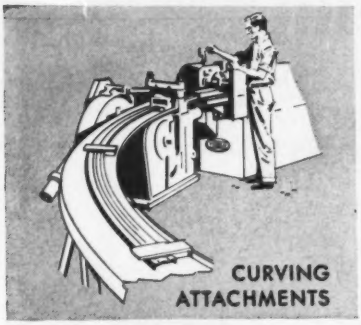

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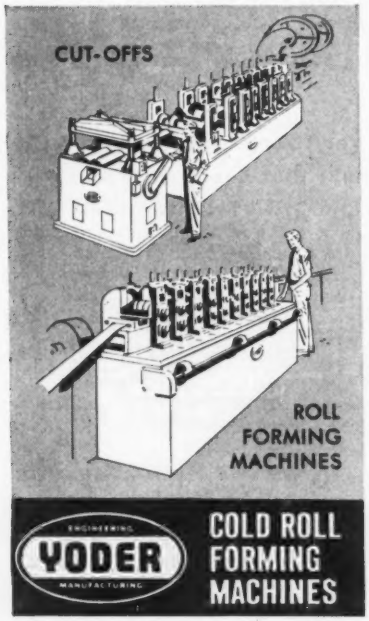


GAGES, Plug and Ring
Brown & Sharpe Mfg. Co., Providence, R. I.
Deltronic, Costa Mesa, Calif.
DoAll Co., Des Plaines, Ill.
Greenfield Tap & Die Corp., Greenfield, Mass.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Pratt & Whitney Co., Inc., West Hartford, Conn.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio
Threadwell Tap & Die Co., 16 Arch, Greenfield, Mass.
Van Keuren Co., 176 Waltham St., Watertown 72, Mass.
Winter Bros. Co., Rochester, Mich.

GAGES, Roll Thread Snap, Adjustable Snap
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.
Greenfield Tap & Die Corp., Greenfield, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio
Threadwell Tap & Die Co., 16 Arch, Greenfield, Mass.

GAGES, Surface Roughness
DoAll Co., Des Plaines, Ill.
Sheffield Corp., Box 893, Dayton 1, Ohio

GAGES, VERNIER, Height, Depth, Gear Tooth
Brown & Sharpe Mfg. Co., Providence, R. I.
DoAll Co., Des Plaines, Ill.
Federal Products Corp., 1144 Eddy St., Providence 1, R. I.

GASKETS
Houghton, E. F. & Co., 303 W. Lehigh Ave., Philadelphia 33 Penna.

GEAR BURNISHERS
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Sheffield Corp., Box 893, Dayton 1, Ohio

GEAR CHAMFERING, ROUNDING AND DEBURRING MACHINES
Bilgram Gear & Mch. Works, 1217-35 Spring Garden St., Philadelphia, Pa.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheffield Corp., Box 893, Dayton 1, Ohio

GEAR CHECKING EQUIPMENT
Brown & Sharpe Mfg. Co., Providence, R. I.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

GEAR CUTTING MACHINES, Bevel and Spiral
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

GEAR CUTTING MACHINES, Worm and Worm Wheels
Barber-Colman Co., 1300 Rock St., Rockford, Ill.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
New Jersey Gear & Mfg. Co., 1470 Chestnut Ave., Hillside, N. J.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.

GEAR GRINDERS—See Grinding Machines, Gear

GEAR HOBBERS
American Schiess Corp., 1232 Penn. Ave., Pittsburgh 22, Pa.
Barber-Colman Co., 1300 Rock St., Rockford, Ill.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Fellows Gear Shaper Co., Springfield, Vt.
Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

GEAR HONERS
National Broach & Mch. Co., 5600 St. Jean, Detroit 13, Mich.

GEAR LAPPERS
Fellows Gear Shaper Co., Springfield, Vt.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
National Broach & Mch. Co., 5600 St. Jean, Detroit 12, Mich.

GEAR MOTORS—See Speed Reducers

GEAR RACKS
Stahl Gear & Mch. Co., The, 3901 Hamilton Ave., Cleveland 4, Ohio.

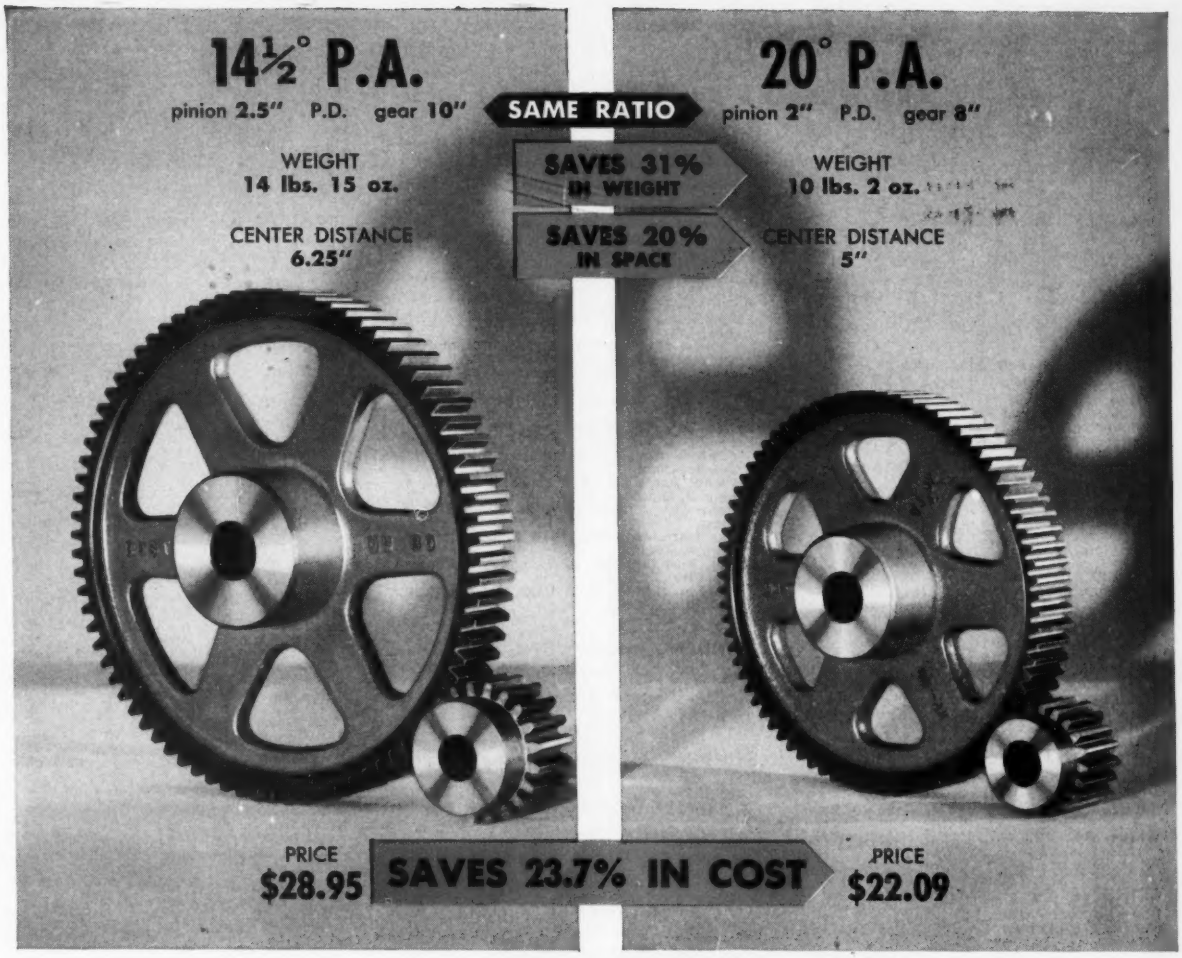
GEAR SHAPERS
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Fellows Gear Shaper Co., Springfield, Vt.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.

GEAR SHAVERS
Fellows Gear Shaper Co., Springfield, Vt.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.

GEARS, AND GEAR BLANKS, Nonmetallic
Boston Gear Works, 14 Hayward St., Quincy 71, Mass.
Cincinnati Gear Co., Wooster Pike and Mariemont Ave., Cincinnati, Ohio.
Diefendorf Gear Corp., Box 934, Syracuse, N. Y.
Greaves Machine Tool Co., 2011 Eastern Ave., Cincinnati, Ohio
New Jersey Gear & Mfg. Co., Hillside, N. J.
Ryerson, Jos. T. & Son, Inc., 16th and Rockwell St., Chicago 8, Ill.
Stahl Gear & Mch. Co., 3901 Hamilton Ave., Cleveland 14, Ohio

GEARS, Cut
Bilgram Gear & Mch. Works, 1217-35 Spring Garden St., Philadelphia, Pa.
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Boston Gear Works, 14 Hayward St., Quincy 71, Mass.
Cincinnati Gear Co., Wooster Pike and Marie mont Ave., Cincinnati, Ohio
Diefendorf Gear Corp., Box 934, Syracuse, N. Y.
Greaves Machine Tool Co., 2011 Eastern Ave., Cincinnati, Ohio.

(Continued on page 240)



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New Jersey Gear Mfg. Co., 1470 Chestnut Ave., Hillside, N. J.
Stahl Gear & Mch. Co., 3901 Hamilton Ave., Cleveland 14, Ohio
Verson Allsteel Press Co., 93rd St., & S. Kenwood Ave., Chicago, Ill.

GRADUATING MACHINES
Gorton Geo., Mch. Co., 1321 Racine St., Racine, Wis.

GREASES—See Lubricating Oils and Greases

GRINDERS, Bench, Floor and Snag
Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Jones & Lamson Mch. Co., Springfield, Vt.
Mummert-Dixon Co., Hanover, Pa.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDERS, Carbide Tool
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
DoAll Co., Des Plaines, Ill.
Elox Corp. of Michigan, Troy, Mich.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Le Maire Machine Tool Co., 2657 S. Telegraph Rd., Dearborn, Mich.
Metallurgical Products Dept. of General Electric Co., Box 237, Roosevelt Park Annex, Detroit 32, Mich.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

GRINDERS, Die and Mold
DoAll Co., Des Plaines, Ill.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDERS, Drill Point
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Consolidated Mch. Tool Div., 565 Blossom Rd., Rochester 10, N. Y.
Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Oliver Instrument Co., 1410 E. Maumee, Adrian, Mich. (also drill point thinner)
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio.

GRINDERS, Face Mill
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Mattison Machine Works, 545 Blackhawk Park Ave., Rockford, Ill.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.

GRINDERS, Knife and Shear
Hill Acme Co., 1201 W. 65th St. Cleveland 2, Ohio
Mattison Machine Works, Rockford, Ill.
Mummert-Dixon Co., Hanover, Pa.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDERS, Portable Electric
Chicago Pneumatic Tool Co., New York 17, N. Y.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati 4, Ohio

GRINDERS, Portable Pneumatic
Chicago Pneumatic Tool Co., New York 17, N. Y.
Madison-Kipp Corp., Madison, Wis.

GRINDERS, Tap
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Jones & Lamson Mch. Co., 160 Clinton St., Springfield, Vt.

GRINDERS, Tool and Cutter
Barber-Colman Co., 1300 Rock St., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling and Grinding Mchs., Cincinnati 9, Ohio
Clausing Div., Atlas Press Co., Kalamazoo, Mich.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Elox Corp. of Michigan, Troy, Mich.
Fellows Gear Shaper Co., 78 River St., Springfield, Vt.
Gallmeyer & Livingston Co., 336 Straight Ave., S. W., Grand Rapids 4, Mich.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
Gorton, Geo., Mch. Co., 1321 Racine St., Racine, Wis.
Landis Tool Co., Waynesboro, Pa.
LeBlond, R. K., Mch. Tool Co. Madison and Edwards Rds., Cincinnati 18, Ohio
Mummert-Dixon Co., Hanover, Pa.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Norton Co., 1 New Bond St., Worcester 6, Mass.
Oliver Instrument Co., 1410 E. Maumee St., Adrian, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place Jersey City 2, N. J.
Thompson Grinder Co., 1500 W. Main St., Springfield, Ohio

GRINDERS, Toolpost
Cosa Corp., 305 Lexington Ave., New York 17, N. Y.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDING GAGES—See Gages, Grinding

GRINDING MACHINES, Abrasive Belt
Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Mattison Mch. Works, Rockford, Ill.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDING MACHINES, Broach
Gallmeyer & Livingston Co., 336 Straight, S. W. Grand Rapids 2, Mich.
National Broach & Mch. Co., 5600 St. Jean, Detroit 13, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Thompson Grinder, 1534 W. Main, Springfield, Ohio

GRINDING MACHINES, Cam
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Landis Tool Co., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

GRINDING MACHINES, Centerless
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Landis Tool Co., Waynesboro, Pa.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

GRINDING MACHINES, Crankshaft
Landis Tool Co., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

GRINDING MACHINES, Cylindrical
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gallmeyer & Livingston Co., 336 Straight, S. W., Grand Rapids 2, Mich.
Hammond Machinery Builders, Inc., Kalamazoo, Mich.
Landis Tool Co., Inc., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio
Standard Electrical Tool Co., 2500 River Rd., Cincinnati 4, Ohio
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

GRINDING MACHINES, Disc
Brown & Sharpe Mfg., Co., Providence, R. I.
Gardner Machine Co., Beloit, Wis.
Mattison Machine Co., Beloit, Wis.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio

GRINDING MACHINES, Gear
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Fellows Gear Shaper Co., Springfield, Vt.
Gear Grinding Machine Co., 3901 Christopher St., Detroit 11 Mich.
Gleason Works, 1000 University Ave., Rochester 3, N. Y.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheffield Corp., Box 893, Dayton 1, Ohio

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Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gallmeyer & Livingston Co., 336 Straight, S. W. Grand Rapids 2, Mich.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Standard Electrical Tool Co. 2488-90 River Rd., Cincinnati, Ohio
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.
Wicaco Machine Corp., Wayne Junction, Philadelphia, Pa.

GRINDING MACHINES, Jig
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Fosdick Mch. Tool Co., 1638 Blue Rock St., Cincinnati 23, Ohio
Gallmeyer & Livingston Co., 336 Straight S. W., Grand Rapids 2, Mich.
Moore Special Tool Co., Inc., 740 Union Ave., Bridgeport, Conn.

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Baker Brothers Inc., 1000 Post Ave., Toledo 10, Ohio
Cincinnati Milling and Grinding Mchs., Inc., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Jones & Lamson Mch. Co., Springfield, Vt.
Sheffield Corp., Box 893, Dayton 1, Ohio

GRINDING MACHINES, Roll
Landis Tool Co., Waynesboro, Pa.
Norton Co., 1 New Bond St., Worcester 6, Mass.

GRINDING MACHINES, Surface Reciprocating
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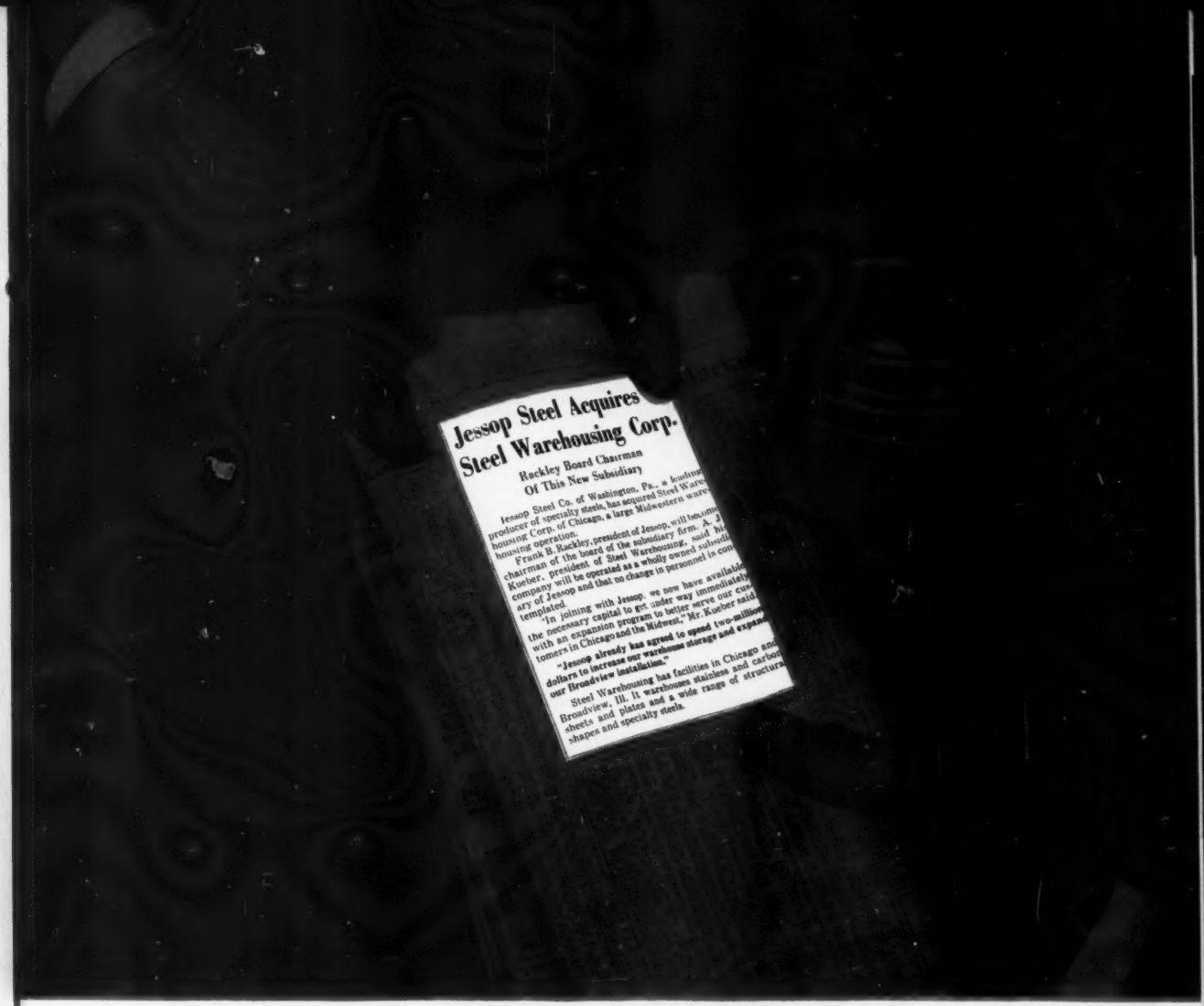
Cincinnati Milling and Grinding Mchs., Inc. Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
DoAll Co., Des Plaines, Ill.
Elox Corp. of Michigan, Troy, Mich.
Gallmeyer & Livingston Co., 336 Straight, S.W. Grand Rapids 4, Wis.
Gardner Machine Co., Beloit, Wis.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio
Homestrand, Inc., Larchmont, N. Y.
Mattison Machine Works, Rockford, Ill.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Thompson Grinder Co., 1500 W. Main St., Springfield, Ohio
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.



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Gardner Machine Co., Beloit, Wis.
Heald Machine Co., 10 New Bond St., Worcester 6, Mass.
Mattison Machine Works, Rockford, Ill.
National Acme Co., 170 E. 131st St., Cleveland 8, Ohio
Norton Co., 1 New Bond St., Worcester 6, Mass.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Thompson Grinder Co., 1500 W. Main St., Springfield, Ohio
Walker, O. S. Co., Inc., Worcester, Mass.

GRINDING MACHINES, Thread

Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
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Landis Machine Co. (Centerless), Waynesboro, Pa.
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Sheffield Corp., Box 893, Dayton 1, Ohio

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Gorton Mch. Co., Geo., 1321 Racine St., Racine, Wis.
Jones & Lamson Mch Co., Springfield, Vt.
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Norton Co., 1 New Bond St., Worcester 6, Mass.
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Metal Carbides Corp., Youngstown, Ohio
Moore Special Tool Co., Inc., 740 Union Ave., Bridgeport 7, Conn.
Norton Co., 1 New Bond St., Worcester 6, Mass.
Sheffield Corp., Box 893, Dayton 1, Ohio

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Barber-Colman Co., 1300 Rock St., Rockford, Ill.
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National Twist Drill & Tool Co., Rochester, Mich.
Orban, Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.

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Shepard Niles Crane & Hoist Corp., Montour Falls, N. Y.

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Barnes Drill Co., 814 Chestnut, Rockford, Ill.
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Moline Tool Co., 102-120th St., Moline, Ill.
Superior Hone Corp., 1623 Elreno St., Elkhart, Ind.
Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

HONING STONES

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Micromatic Hone Corp., 8100 Schoolcraft Ave., Detroit 38, Mich.
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Cross Co., 3250 Bellevue Ave., Detroit 7, Mich.
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Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Michigan Drill Head Co., Detroit 34, Mich.
Modern Ind. Engrg. Co., 14230 Birwood Ave., Detroit 4, Mich.
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Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
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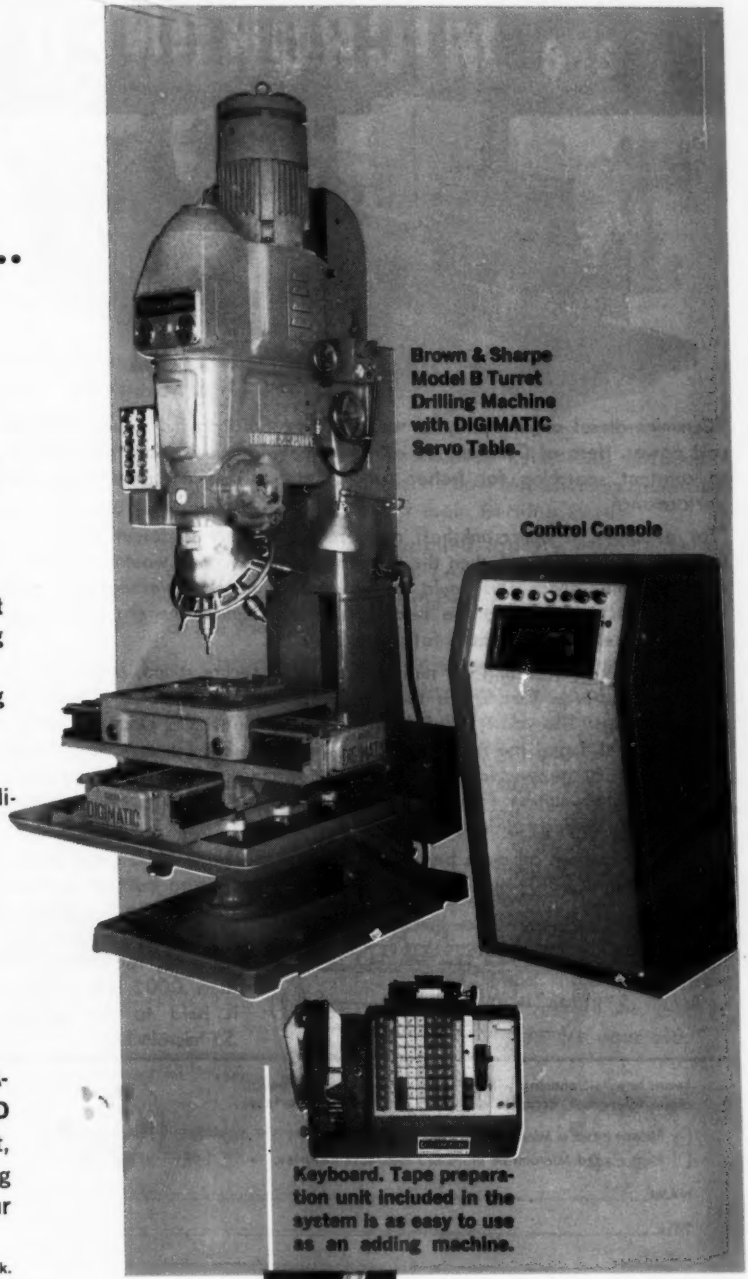

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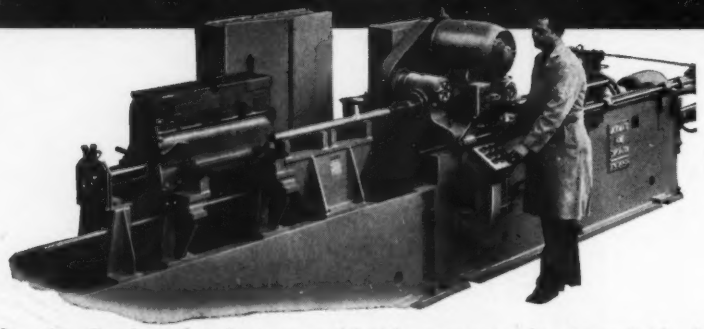
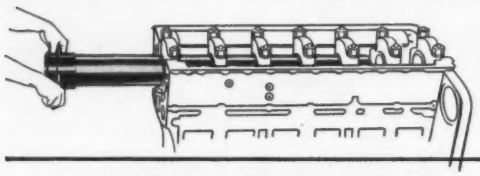


"Cummins diesel engines have a world-wide reputation for dependable, low-cost power. Here at Cummins, we attribute the wide acceptance of our engines to constant searching for better processing methods and improved engine performance.

"For example, if our crankshaft main bearings were undercut at the ends, tapered or out-of-round, then the full load of the journals would be borne by relatively small areas. This would cause bearing inserts to overheat and quickly break down. Also, should the bearings be misaligned, the crankshaft would flex during rotation and cause fatigue failure.

"However, by Microhoning our main bearings we secure *round, accurately-sized* and *aligned bores*. Cummins is the first diesel manufacturer to Microhone its main bearings. The surfaces of Microhoned bearings are clean-cut, free of deformed metal and the finish is consistent in every bore. In addition, the consistent accuracy generated by Microhoning permits us to make faster set-ups and use higher cutting feeds on preceding boring operations—Microhoning automatically corrects all inaccuracies.

"After Microhoning, all main bearing bores are checked with a gage plug 44 inches long and .0007 inch under required bore size. Gage must have a simultaneous slip-fit through all bores in the block. Tolerance for roundness is less than .0002 inch and finish is held to the specified 55 microinches."



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Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Hartford Special Machinery Co., 287 Homestead Ave., Hartford 12, Conn.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Le Maire Machine Tool Co., 2657 S. Telegraph Rd., Dearborn, Mich.
Michigan Drill Head Co., Detroit 34, Mich.
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Vickers Incorporated, Div. of Sperry Rand Corporation, 1402 Oakman Blvd., Detroit, Mich.

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Eisler Engrg. Co., Inc., 750 South 13th St., Newark, N. J.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
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Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
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Opto-Metric Tools, Inc., 137 Varick St., New York, N. Y.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.
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du Mont Corp., Greenfield, Mass.
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JACKS, Planer—See Set-up Equipment

JIG BORERS

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(Continued on page 245)

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Sheldon Mch. Co., Inc., 4258 N. Knox Ave. Chicago 41, Ill.
Sidney Mch. Tool Co., Sidney, Ohio
Williams, J. H. & Co, 400 Vulcan St., Buffalo 7, N. Y.

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LATHES, Axle

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Hamilton Div., Baldwin-Lima-Hamilton Corp Hamilton, Ohio
Monarch Mch. Tool Co., Oak St., Sidney, Ohio
Orban, Kurt Co., Inc., 42 Exchange Place Jersey City 2, N. J.
Sundstrand Mch. Tool Co., 2531 11th St. Rockford, Ill.

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Hardinge Bros., Inc., 1420 College Ave., Elmira, N. Y.
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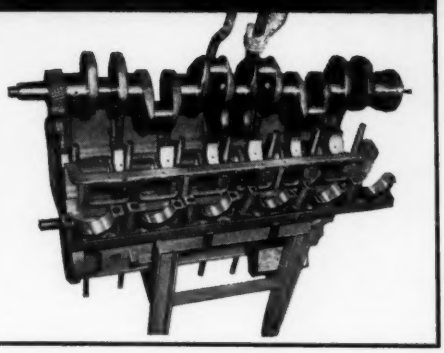
HOW MICROHONING generates round, accurate, aligned bearing bores



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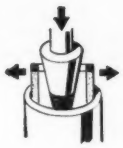

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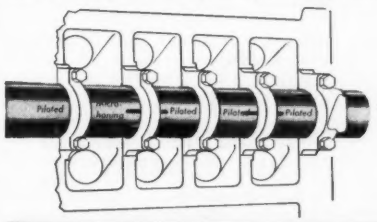

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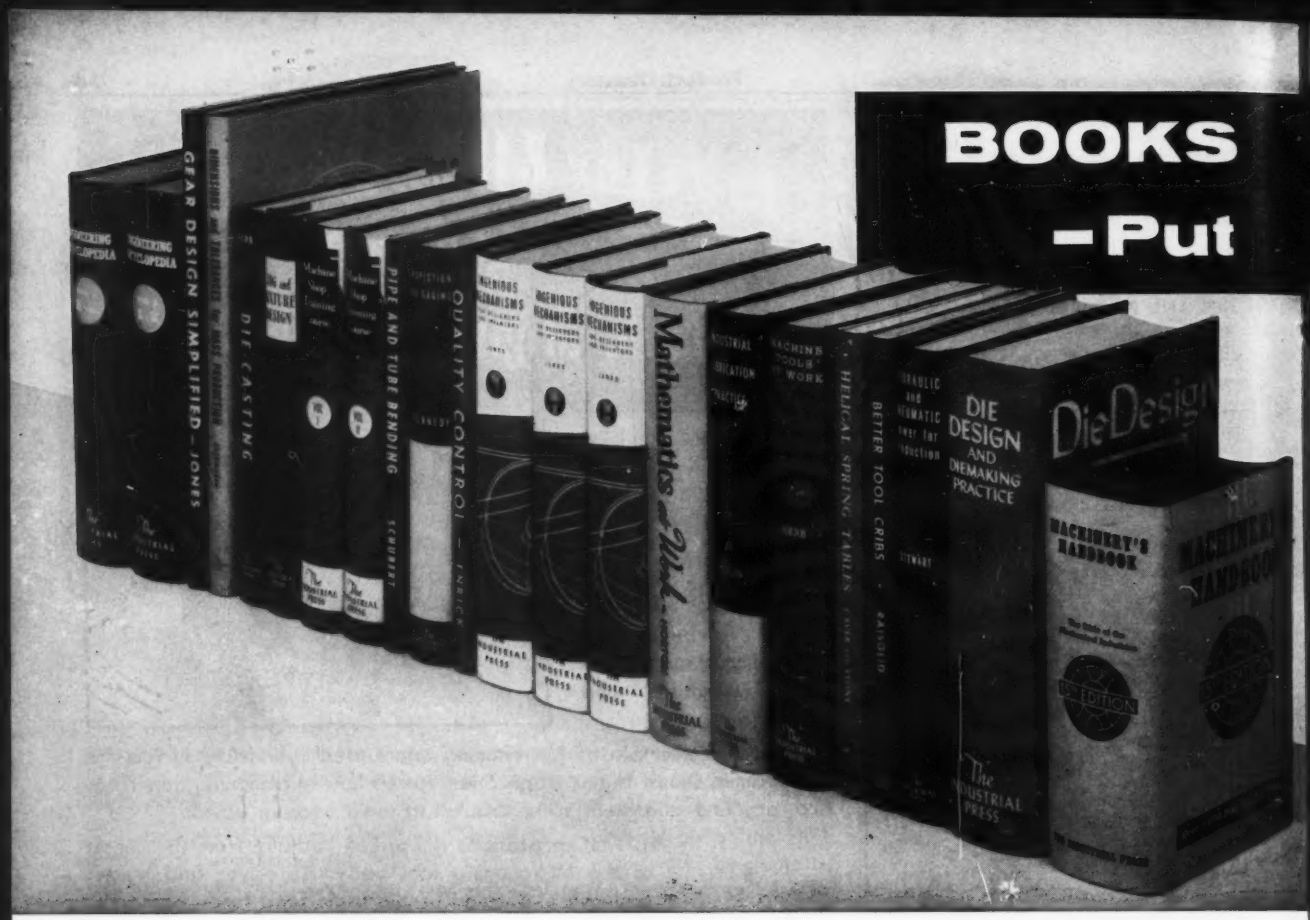

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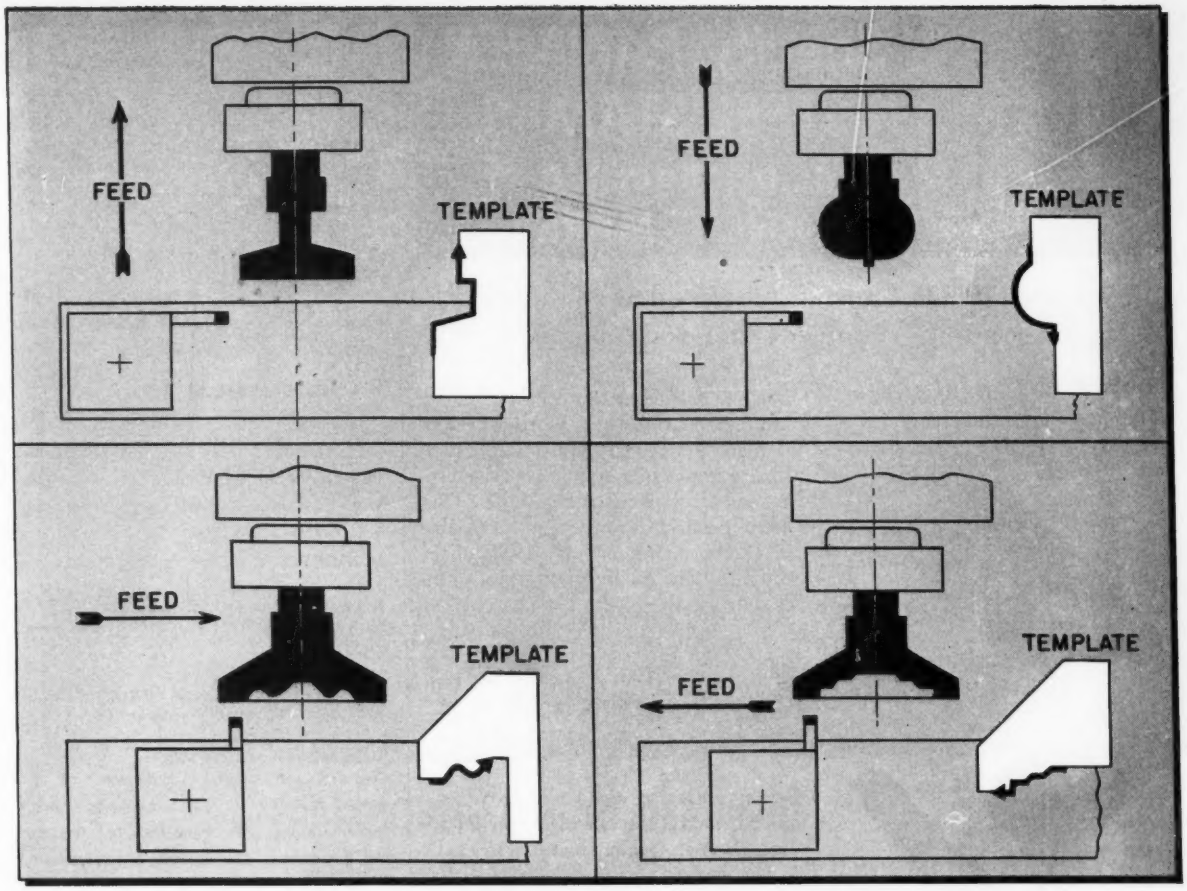

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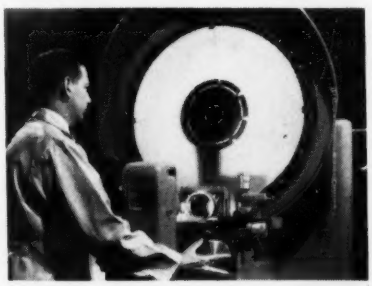

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Van Norman Machine Co., 3640 Main St., Springfield 7, Mass.

MILLING MACHINES, Knee Type Rise and Fall

Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Nichols, W. H. Co., Waltham 54, Mass.
Orban, Kurt Co., 42 Exchange Place, Jersey City, N. J.

MILLING MACHINES, Knee Type Turret

Gorton Mch. Co., 1321 Racine St., Racine, Wis.

MILLING MACHINES, Knee Type, Vertical

Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling & Grinding Mches., Inc. 4701 Marburg Ave., Cincinnati 9, Ohio
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Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
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Espen-Lucas Mch. Works, Front St. and Girard Ave., Philadelphia, Pa.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
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Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Kearney & Trecker, Corp., 6784 W. National, Milwaukee 14, Wis.
Orban, Kurt Co., Inc., 42 Exrhange Place, Jersey City, N. J.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

MILLING MACHINES, Spar

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Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
Hamilton Div., Baldwin-Lima-Hamilton Corp., Hamilton, Ohio
Kearney & Trecker Corp., 6784 W. National, Milwaukee 14, Wis.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

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Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinati 29, Ohio
Fellows Gear Shaper Co., 78 River St., Springfield, Vt.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Wood, R. D., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

MOTORS, Air

Ingersoll-Rand Co., Phillipsburg, N. J.

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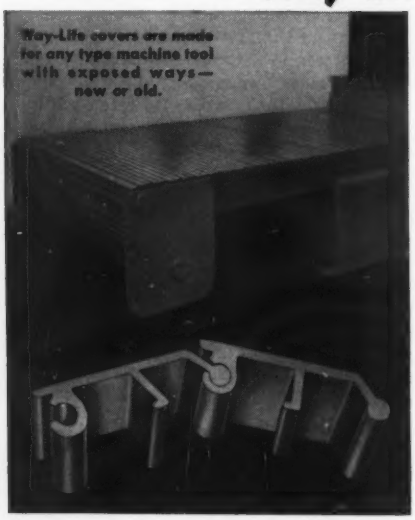

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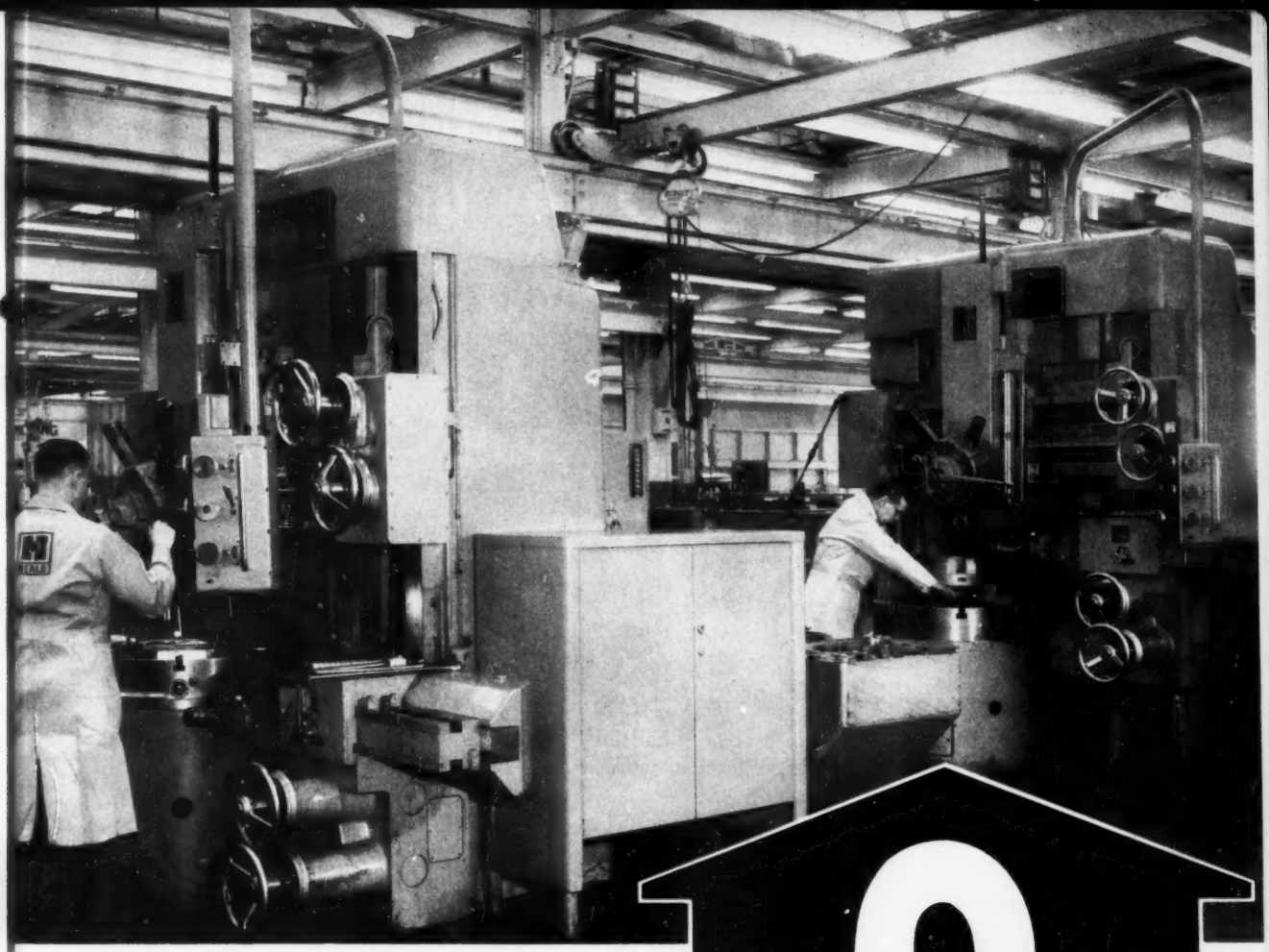

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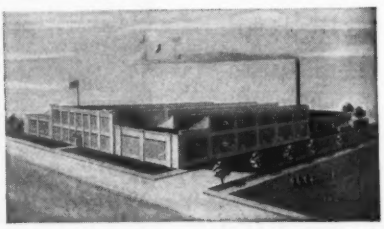

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Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
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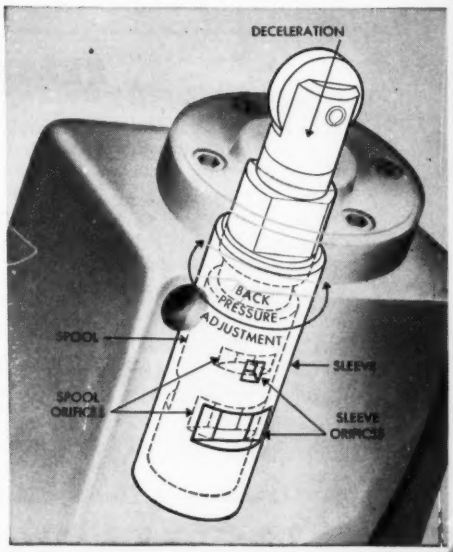

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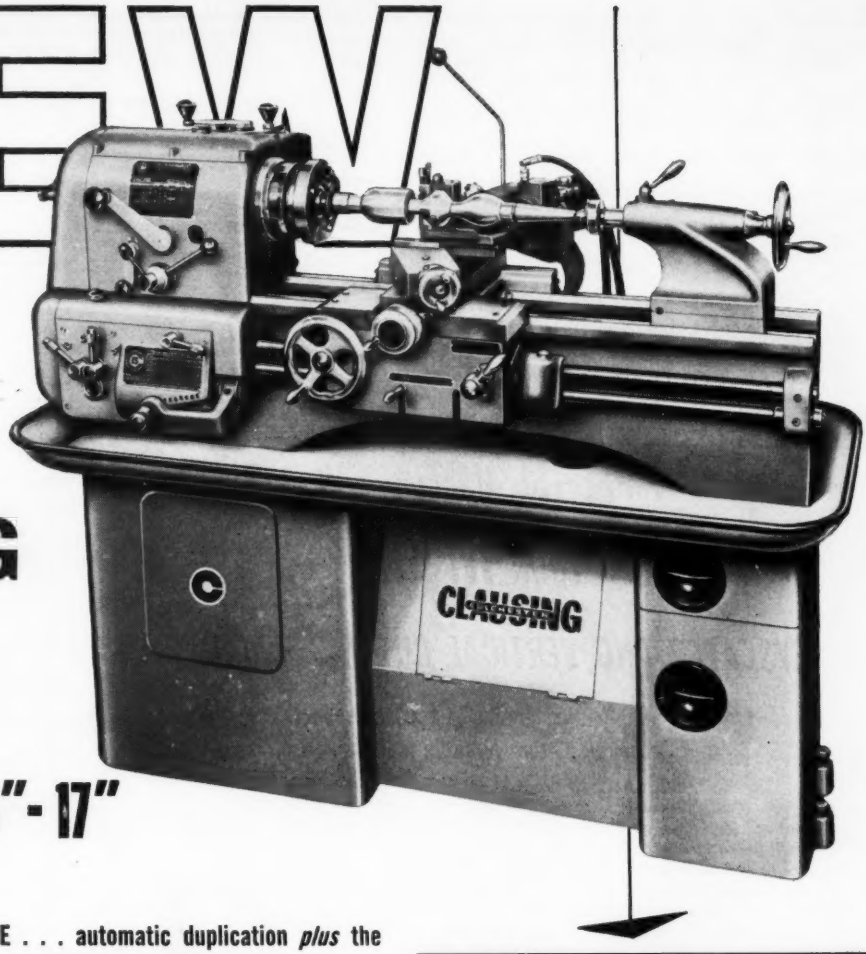

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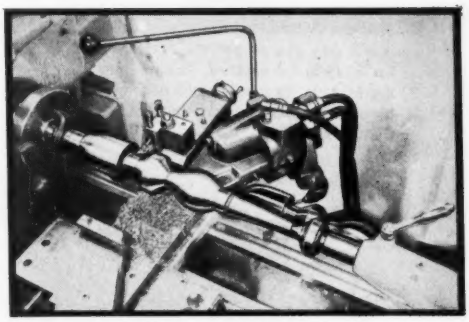
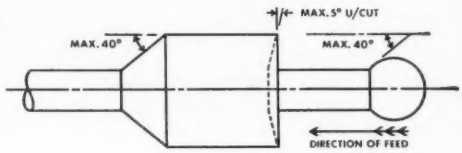


Maximum profiling capacities of Clausing geared-head lathes are indicated below.



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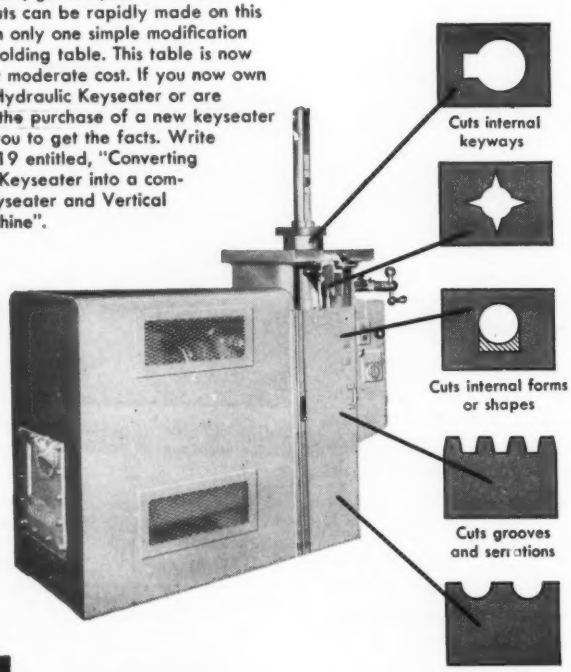

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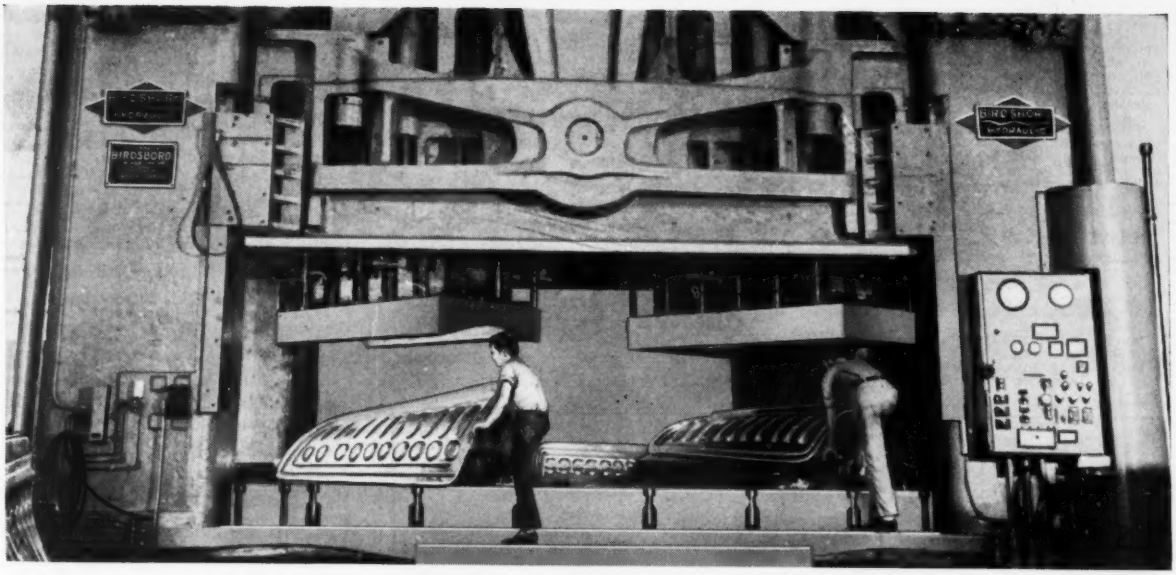
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Danly Machine Specialties, Inc., 2100 South Laramie, Chicago 50, Ill.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio



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PRESSES, Die Sinking (Hobbing)

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S.W., Canton, Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.
Wood, R. D., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

PRESSES, Die Tryout

Bliss, E. W. Co., 1375 Raff Rd., S.W., Canton, Ohio
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Elmes Eng Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Federal Press Co., 511 Division St., Elkhart, Ind.
Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.

PRESSES, Drawing

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S.W., Canton, Ohio
Cincinnati Milling & Grinding Machines, Inc., 4710 Marburg Ave., Cincinnati 9, Ohio
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Crane & Engineering Co., Wickliffe, Ohio
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Danly Machine Specialties, Inc., 2100 South Laramie, Chicago 50, Ill.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.
Wood, R. D., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

PRESSES, Extrusion

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S.W., Canton, Ohio
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Danly Machine Specialties, Inc., 2100 South Laramie, Chicago 50, Ill.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.

PRESSES, Foot

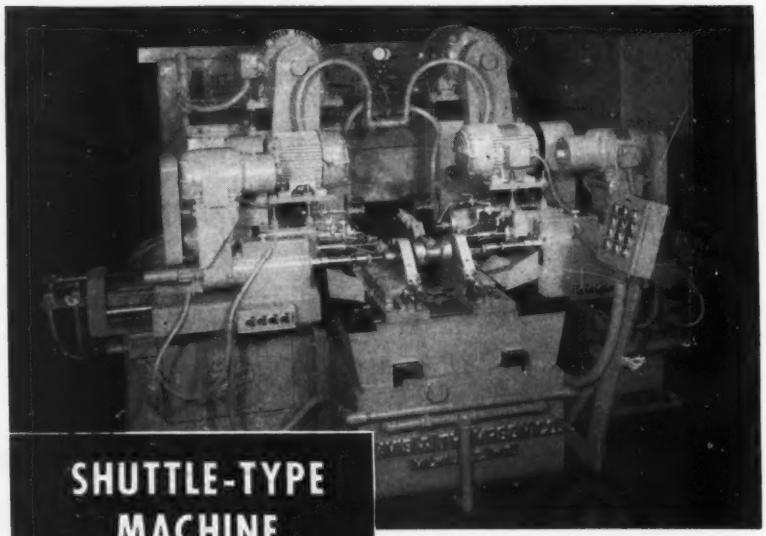
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Producto Machine Co., 985 Housatonic Ave., Bridgeport 1 Conn.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.

PRESSES, Horning

Bliss, E. W. Co., 1375 Raff Rd., S.W., Canton, Ohio
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wood, R. D., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

PRESSES, Notching

Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wales-Strippit, Inc., Akron, N. Y.



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Here's a good example of engineering a semi-standard machine to handle a lot of parts. Although this machine has been adapted to milling, centering, drilling and tapping of valve parts, its basic design lends itself to other operations through the addition of various types of heads as well as multiple spindle drill heads. Machine incorporates hydraulic controls for table feed and index, two milling heads, two hydraulic power heads, each with center drill and tap drill spindle, and two mechanical screw feed tapping heads to accommodate 16, 20 and 24 pitch threads. Capacities range from ⅜" to 4½" diameter, 5" to 23" long. Parts are inner valves for liquid level controls of tough #316 stainless steel.

If you need high production of one part or moderate production of many parts *with a minimum capital outlay*, it will pay you to call in a D & T production engineer. There is no obligation for this service.

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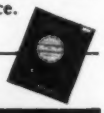

Roto-Matic
Davis and Thompson Co.
4460 N. 124th ST. MILWAUKEE 18, WISCONSIN

PRESSES, Punching, Piercing
Beatty Machine & Mfg. Co., Hammond, Ind.
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S.W., Canton, Ohio
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Crane & Engineering Co., Wickliffe, Ohio
Cleveland Punch & Shear Wks. Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Danly Machine Specialties, Inc., 2100 South Laramie, Chicago 50, Ill.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Federal Press Co., 511 Division St., Elkhart, Ind.
Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Wales-Strippit, Inc., Akron, N. Y.
Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.
Wood, R. D., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

PRESSES, Quenching
Gleason Wks., 1000 University Ave., Rochester 3, N. Y.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio

PRESSES, Rubber-Forming
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S.W., Canton, Ohio
Chambersburg Engineering Co., Chambersburg, Pa.
Cincinnati Milling & Grinding Machines, Inc., 4701 Marburg Ave., Cincinnati 9, Ohio
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St., Erie, Penna.
Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9303 S. Kenwood Ave., Chicago 19, Ill.
Wood, R. D., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

PRESSES, Trimming
Beatty Machine & Mfg. Co., Hammond, Ind.
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Bliss, E. W. Co., 1375 Raff Rd., S.W., Canton, Ohio
B-T Machinery Co., Holland, Mich.
Chambersburg Engineering Co., Chambersburg, Pa.
Clearing Div., of U. S. Industries, Inc., 6499 W. 65th St., Chicago 38, Ill.
Cleveland Punch & Shear Wks., Co., 3917 St. Clair Ave., Cleveland 14, Ohio
Danly Machine Specialties, Inc., 2100 South Laramie, Chicago 50, Ill.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Erie Foundry Co., 1253 W. 12th St, Erie, Penna.
Federal Press Co., 511 Division St., Elkhart, Ind.
Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.
Hydraulic Press Mfg. Co., Mount Gilead, Ohio
L & J Press Corp., 1631 Sterling Ave., Elkhart, Ind.
Minster Machine Co., Minster, Ohio
Niagara Machine & Tool Wks., 637 Northland Ave., Buffalo 11, N. Y.
Verson Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.

PROFILING MACHINES—See Milling Machines, Die Sinking, etc.

PULLEYS
Brown & Sharpe Mfg. Co., Providence, R. I.
DoALL Co., Des Plaines, Ill.

PUMPS, Coolant and Lubricant
Barnes, John S., Corp., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
DoALL Co., Des Plaines, Ill.
Ingersoll-Rand Co., Phillipsburg, N. J.
Little Giant Pump Co., 5101 Classen Blvd., Oklahoma City 18, Okla.
Logansport Machine Co., Inc., 810 Center Ave., Logansport, Ind.
Ruthman Machinery Co., 1809 Reading Rd., Cincinnati, 2, Ohio

PUMPS, Hydraulic
Barnes, John S., Corp., Rockford, Ill.
Brown & Sharpe Mfg. Co., Providence, R. I.
Denison Engineering, Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio
Elmes Eng. Div., American Steel Foundries, 1150 Tennessee Ave., Cincinnati 29, Ohio
Hydraulic Press Mfg. Div., Mount Gilead, Ohio
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Sundstrand Machine Tool Co., 2531 11th St., Rockford, Ill.
Vickers Inc., Administrative & Engineering Center, Box 302, Detroit 32, Mich.

PUNCHES AND DIES—See Dies, Blanking, etc.

REAMERS, Rose, Chucking, Jobbers Taper, Shell, Adjustable, etc.
Barber-Colman Co., 1300 Rock St., Rockford, Ill.
Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill.
Cleveland Twist Drill Co., 1242 49th St., Cleveland, Ohio
Cogsdill Twist Drill Co., Greenfield, Mass.
DoALL Co., Des Plaines, Ill.

(Continued on page 262)

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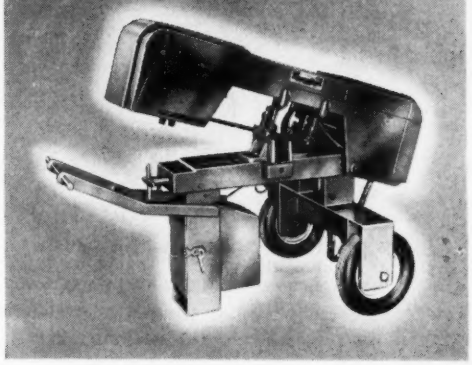

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U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.

REFRACTORS Heat-Treating Furnaces
Norton Co., 1 New Bond St., Worcester 6, Mass.

RETAINING RINGS
Waldes Kohinoor, Inc., 47-16 Austel Pl., Long Island City 1, N. Y.

RIVETERS, Portable
Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.
Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.

RIVETERS, Stationary
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Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.
Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.
Tompkins-Johnson Co., 617 N. Mechanic St., Jackson, Mich.

ROTARY TABLES, Optical
Machine Products Corp., 6771 E. McNichols Rd., Detroit 12, Michigan

RULES, SCALES AND STRAIGHTEDGES
See Machinists' Small Tools

RUST INHIBITORS
Houghton, E. F. & Co., 303 W. Lehigh Ave., Philadelphia 33, Penna.
Oakite Products, Inc., 26 Rector St., New York, N. Y.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Shell Oil Co., 50 W. 50th St., New York, N. Y.
Stuart, D. A. Oil Co., Ltd., 2727 S. Troy St., Chicago 23, Ill.

SAND BLAST EQUIPMENT—See Blast Cleaning Equipment

SAW BLADES, Hack, Band, Circular Friction
Armstrong-Blum Mfg. Co., 5700 W. Bloomingdale Ave., Chicago, Ill.
Capewell Mfg. Co., 60 Governor St., Hartford, Conn.
Circular Tool Co., Inc., 765 Allens Ave., Providence 5, R. I.
DoALL Co., Des Paines, Ill.
Espen-Lucas Mach Works, Philadelphia, Pa.
Motch & Merryweather Mchy. Co., 888 E. 70th St., Cleveland 3, Ohio

SAW BLADE SHARPENERS
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Espen-Lucas Machine Works, Front St. and Girard Ave., Philadelphia, Pa.
Motch & Merryweather Mchy. Co., 888 E. 70th St., Cleveland 3, Ohio

SAWING MACHINES, Abrasive Machines—See Cutting-off Saws, Abrasive Wheel

SAWING MACHINES, Band
Armstrong-Blum Mfg. Co., 5700 W. Bloomingdale Ave., Chicago, Ill.
DoALL Co., Des Plaines, Ill.

SAWING MACHINES, Circular Blade
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Espen-Lucas Machine Works, Front St. and Girard Ave., Philadelphia, Pa.
Motch & Merryweather Mchy. Co., 888 E. 70th St., Cleveland 3, Ohio
Ty-Sa-Man Machine Co., Inc., 1093 White Ave., Knoxville, Tenn.

SAWING MACHINES, Power Hack
Armstrong-Blum Mfg. Co., 5700 W. Bloomingdale Ave., Chicago, Ill.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York 17, N. Y.

SAWS, Screw-slotting—See Cutters, Milling

SCREW DRIVERS, STUD AND NUT SETTERS, Power
Bodine Corp., 317 Mt. Grove St., Bridgeport 5, Conn.
Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Scully-Jones & Co., 1906 Rockwell St., Chicago 8, Ill.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

SCREW MACHINES, Hand—See Lathes, Turret, Ram-type, Saddle-type

SCREW MACHINES, Multiple-Spindle Automatic
Greenlee Bros. & Co., 2136 12th St., Rockford, Ill.
National Acme Co., 170 E. 31st St., Cleveland, Ohio
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
Scherr, George Co., Inc., 200 Lafayette St., New York 12, N. Y.
Warner & Swasey Co., 6701 Carnegie Ave., Cleveland 3, Ohio

SCREW MACHINES, Single-Spindle Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Gear Grinding Machine Co., 3901 Christopher St., Detroit 11, Mich.
Gisholt Mch. Co., 1245 E. Washington Ave., Madison 10, Wis.
Gorton, George Mch. Co., 1110 W. 13th St., Racine, Wis.
National Acme Co., 170 E. 131st St., Cleveland, Ohio
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.

SCREW PLATES
Greenfield Tap & Die Corp., Greenfield, Mass.
Threadwell Tap & Die Co., 16 Arch St., Greenfield, Mass.

SCREWS, Cap, Set, Self-tapping, etc.—See Bolts, Nuts and Screws

SEALS AND RETAINERS—Oil or Grease
Crane Packing Co., 6400 Oakton St., Morton Grove, Ill.
Gits Bros. Mfg. Co., 1858 S. Kilbourn Ave., Chicago, Illinois

SEPARATORS, Magnetic
Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Sundstrand Mch. Tool Co., 2531 11th St., Rockford, Ill.

SET-UP EQUIPMENT
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Lufkin Rule Co., Saginaw, Mich.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

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Cincinnati Shaper Co., P. O. Box 111, Cincinnati 11, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Nebel Machine Tool Corp., 3401 Central Pkwy, Cincinnati 25, Ohio
Orban Kurt Co., Inc., 42 Exchange Place, Jersey City 2, N. J.
Rockford Mch. Tool Co., 2500 Kishwaukee St., Rockford, Ill.
Sheldon Mch. Co., Inc., 4240-4258 N. Knox Ave., Chicago 41, Ill.

SHAPERS, Vertical and Slotters
Bridgeport Mches., Inc., 500 Lindley St., Bridgeport 6, Conn.
Consolidated Mch. Tool Div., Blossom Road, Rochester 10, N. Y.
Orban, Kurt Co., 42 Exchange Place, Jersey City 2, N. J.
Rockford Mch. Tool Co., 2500 Kishwaukee St., Rockford, Ill.

SHEARS, Alligator
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio

SHEARS, Guillotine Bar
Beatty Machine & Mfg. Co., Hammond, Ind.

SHEARS, Rotary
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Niagara Mch. & Tool Works, 683 Northland Ave., Buffalo, N. Y.

SHEARS, Squaring
Birdsboro Steel Fdy. & Mch. Co., Birdsboro, Pa.
Cincinnati Shaper Co., P. O. Box 111, Cincinnati 11, Ohio
Cosa Corp., 405 Lexington Ave., New York 17, N. Y.
Lodge & Shipley Co., 3055 Colerain Ave., Cincinnati 25, Ohio
Niagara Mch. & Tool Works, 683 Northland Ave., Buffalo, N. Y.

SHEET METALS—See Strip and Sheet, Ferrous, Non-ferrous

SHIM STOCK
Laminated Shim Co., Inc., Glenbrook, Conn.

SLITTING MACHINES, Rotary
Bliss Co., E. W., Canton, Ohio
Niagara Mch. & Tool Works, 683 Northland Ave., Buffalo 11, N. Y.
Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.
Yoder Co., 5504 Walworth Ave., Cleveland 2, Ohio

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National Acme Co., 170 E. 131st St., Cleveland 3, Ohio
Vickers Inc., Administrative & Engineering Center, Box 302, Detroit 32, Mich.

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Baird Machine Co., 1700 Stratford Ave., Stratford, Conn.
Barnes Drill Co., 814 Chestnut, Rockford, Ill.
Barnes, W. F. & John Co., 201 S. Water St., Rockford, Ill.
Baush Machine Tool Co., 156 Wason Ave., Springfield 7, Mass.
Bethlehem Steel Co., Bethlehem, Pa.
Bilgram Gear & Mch. Works, 1217-35 Spring Garden St., Philadelphia, Pa.
Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.
Blanchard Mch. Co., 64 State St., Cambridge, Mass.
Bliss, E. W. Co., 1375 Raff Rd., S. W., Canton, Ohio
Buhr Mch. Tool Co., 839 Green St., Ann Arbor, Mich.
Burg Tool and Mfg. Co., Inc., 15001 S. Figueroa, Gardena, Calif.
Chambersburg Engrg. Co., Chambersburg, Pa.
Cincinnati Milling Mch. Co., Oakley, Cincinnati 9, Ohio.
Columbus Die-Tool & Mch. Co., 955 Cleveland Ave., Columbus, Ohio.
Consolidated Mch. Tool Corp., Rochester, N. Y.
Cross Co., 3250 Bellevue, Detroit 7, Mich.
Erie Foundry Co., Erie, Pa.
Espen-Lucas Mch. Works, Front St. and Girard Ave., Philadelphia, Pa.
Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
Federal Machine & Welder Co., Overland Ave., Warren, Ohio.
Fellows Gear Shaper Co., 78 River St., Springfield, Vt.
Gisholt Machine Co., 1245 E. Washington Ave., Madison 10, Wis.
Gorton, Geo., Mch. Co., 1110 W. 13th St., Racine, Wis.
Greenlee Bros. & Co., 12th and Columbia Aves., Rockford, Ill.
Hannifin Co., Div. Parker-Hannifin Corp., Des Plaines, Ill.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio.
Hydraulic Press Mfg. Co., Mt. Gilead, Ohio.
Ingersoll Milling Machine Co., 505 Fulton Ave., Rockford, Ill.
Kingsbury Mch. Tool Corp., Keen, N. H.
Lamb, F. Joseph Co., 5663 E. Nine Mile Rd., Detroit 34, Mich.
Le Maire Machine Tool Co., 2657 S. Telegraph Rd., Dearborn, Mich.
Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
Modern Industrial Engrg. Co., 14230 Birwood, Detroit 4, Mich.
Moline Tool Co., 102 20th St., Moline, Ill.
Motch & Merryweather Mchy. Co., 888 E. 70th St., Cleveland 3, Ohio.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
National Automatic Tool Co., Inc., S. 7th and N Sts., Richmond, Ind.
National Broach & Mch. Co., 5600 St. Jean Ave., Detroit 2, Mich.
National Twist Drill & Tool Co., Rochester, Mich.
New Britain Mch. Co., New Britain-Gridley Mch. Div., New Britain, Conn.
New Jersey Gear & Mfg. Co., 1470 Chestnut Ave., Hillside, N. J.
Niagara Mch. & Tool Works, 683 Northland Ave., Buffalo, N. Y.
Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Sheffield Corp., Box 893, Dayton 1, Ohio
Snyder Tool & Engrg. Co., 3400 E. Lafayette, Detroit 7, Mich.
Standard Electrical Tool Co., 2488-90 River Rd., Cincinnati, Ohio.
Sundstrand Mch. & Tool Co., 2531 11th St., Rockford, Ill.
Universal Engrg. Co., Frankenmuth 2, Mich.
Vernon Allsteel Press Co., 93rd St., & S. Kenwood Ave., Chicago, Ill.
Wicaco Machine Corp., Wayne Junction, Philadelphia, Pa.

SPEED REDUCERS

Barnes, John S. Corp., Rockford, Ill.
Boston Gear Works, 320 Main St., North Quincy 71, Mass.
Horsburgh & Scott Co., 5114 Hamilton, Cleveland, Ohio.
James, D. O., Gear Mfg. Co., 1140 W. Monroe St., Chicago 7, Ill.

SPINDLES, Machine

Ex-Cell-O Corp., 1200 Oakman Blvd., Detroit 32, Mich.
National Automatic Tool Co., S. 7th and N Sts., Richmond, Ind.
Standard Electrical Tool Co., 2488-90 River Road, Cincinnati, Ohio.

SPRAYING EQUIPMENT, Metal

Metallizing Eng. Co., Westbury, L. I., N. Y.

SPROCKETS—See Gears, Cut

STAMPINGS, Sheet Metal

Laminated Shim Co., Inc., Glenbrook, Conn.
Revere Copper & Brass Inc., 230 Park Ave., New York, N. Y.

STEEL ALLOYS—See Alloy Steels

STEEL, Cold Rolled, Stainless, High-speed, Tool, etc.

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
Bethlehem Steel Co., Bethlehem, Pa.
Carpenter Steel Co., 105 W. Bern St., Reading, Penna.
Jessop Steel Co., Washington, Penna.
Ryerson, Jos. T., & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.
Timken Roller Bearing Co., Canton, Ohio.
Vanadium-Alloys Steel Co., Latrobe, Penna.
Wheelock, Lovejoy & Co., Inc., Cambridge, Mass.

STEEL DISTRIBUTORS

Ryerson, Jos. T., & Son, 16th & Rockwell Sts., Chicago 8, Ill.

STOCKS AND DIES

DoALL Co., Des Plaines, Ill.
Hill Acme Co., 1201 W. 65th St., Cleveland 2, Ohio.
Landis Mch. Co., Waynesboro, Pa.
Threadwell Tap & Die Co., Greenfield, Mass.

STRAIGHTEDGES—See Machinists' Small Tools

STRAIGHTENERS, Flat Stock and Wire

Bliss Co., E. W., Canton, Ohio.
Niagara Mch. & Tool Wks., 637-697 Northland Ave., Buffalo 11, N. Y.
U. E. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J.
Vernon Allsteel Press Co., 9309 S. Kenwood Ave., Chicago 19, Ill.
Waterbury Farrel Foundry & Mach. Co., Waterbury, Conn.

STRIP AND SHEET, Ferrous

Allegheny Ludlum Steel Corp., Pittsburgh, Pa.
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Carpenter Steel Co., 105 W. Bern St., Reading, Penna.
Ryerson, Jos. T., & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

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Bridgeport Brass Co., Bridgeport, Conn.
Jessop Steel Co., Washington, Penna.
Ryerson, Jos. T., & Son, Inc., 16th & Rockwell Sts., Chicago 8, Ill.

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Buhr Machine Tool Co., 839 Greene St., Ann Arbor, Mich.
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Chicago Pneumatic Tool Co., 6 E. 44th St., New York 17, N. Y.
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Cross Co., P. O. Box 3835, Park Grove Postal Sta., Detroit 5, Mich.
Edlund Machinery Co., Cortland, N. Y.
Elox Corp. of Michigan, Troy, Mich.
Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37, N. Y.
Hamilton Tool Co., 834 S. 9th St., Hamilton, Ohio.
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Kaufman Manufacturing Co., Manitowac, Wis.
Kingsbury Mch. Tool Corp., Keene, N. H.
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Le Maire Machine Tool Co., 2657 S. Telegraph Rd., Dearborn, Mich.
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Jarvis Corp., Stack Ave., Middletown, Conn.
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Winter Bros. Co, Rochester, Mich.

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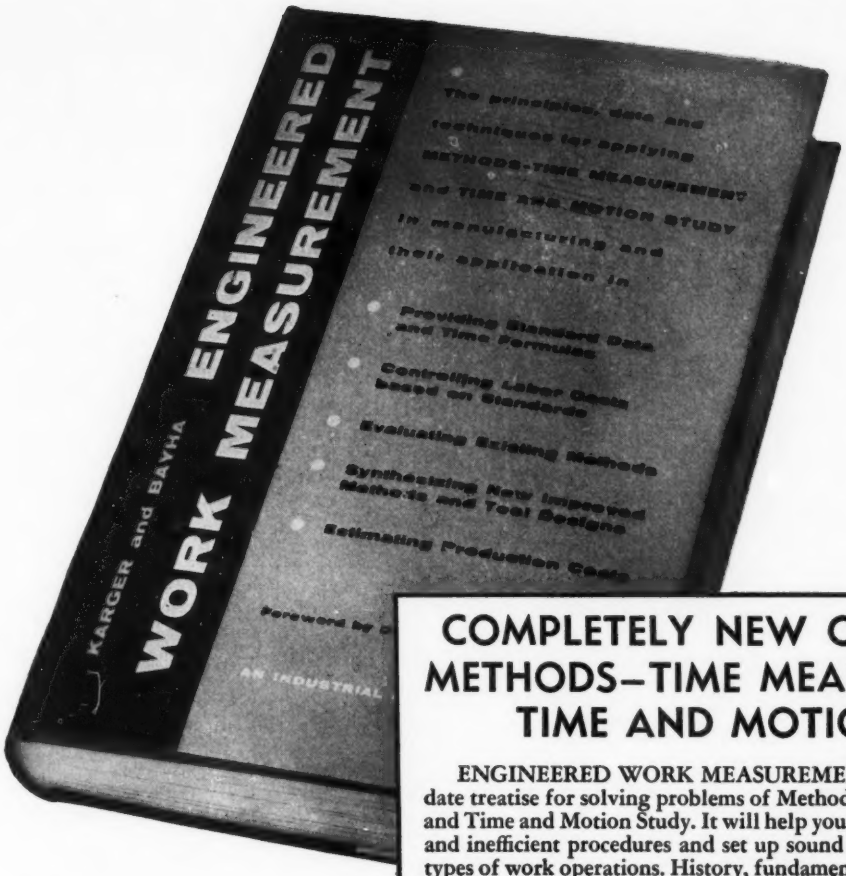
Geometric-Horton Div., United Greenfield Corp., New Haven, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Landis Mch. Co., Waynesboro, Pa.
National Acme Co., 170 E. 131st St., Cleveland, Ohio.
Sheffield Corp., Box 893, Dayton 1, Ohio.



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Landis Mch. Co., Waynesboro, Pa.
Sheffield Corp., Box 893, Dayton 1, Ohio.

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National Machinery Co., Tiffin, Ohio.
Reed Rolled Thread Die Co., P. O. Box 350, Worcester 1, Mass.
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Cleveland Twist Drill Co., 1242 E. 49th St., Cleveland 14, Ohio.
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DeVlieg Microbore Div., 2720 W. Fourteen Mile Road, Royal Oak, Mich.
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Metal Carbides Corp., 6001 Southern Blvd., Youngstown 12, Ohio.
Vascoloy-Ramet Corp., Waukegan, Ill.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.
Williams, J. H. & Co., 400 Vulcan St., Buffalo 7, N. Y.

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Vascoloy-Ramet Corp., Waukegan, Ill.

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Giddings & Lewis Machine Tool Co., Fond du Lac, Wis.
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TRANSFER MACHINES
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Boston Gear Wks., Quincy, Mass.
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Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
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Ryerson, Jos. T., & Son, Inc., 16th & Rockwell Sts., Chicago 18, Ill.

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Carpenter Steel Co., 105 W. Bern St., Reading, Penna.
Metal Forming Corp., Elkhart, Ind.
National Tube Div., U. S. Steel Corp., 525 Wm. Penn Place, Pittsburgh, Pa.
Revere Copper & Brass Inc., 230 Park Ave., New York 17, N. Y.
Ryerson, Jos. T., & Son, Inc., 16th & Rockwell Sts., Chicago 18, Ill.
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Vickers Inc., Administrative & Engineering Center, Box 302, Detroit 32, Mich.

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Hydraulic Press Mfg. Div., Mt. Gilead, Ohio.
Logansport Mch. Co., Inc., Logansport, Ind
Mechanical Air Controls, Inc, Oak Park, Mich.
Ross Operating Valve Co., 110 E. Golden Gate Ave., Detroit 3, Mich.
Schrader's Son, A., 470 Vanderbilt Ave., Brooklyn 38, N. Y.
Skinner Electric Valve Div., New Britain, Conn.
Tomkins-Johnson Co., 617 N. Mechanic St., Jackson, Mich.

VALVES, Hydraulic
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Denison Engineering Div. American Brake Shoe Co., 1152 Dublin Rd., Columbus 16, Ohio.
Elmes Eng. Div., American Steel Foundries, 1150 Tennesee Ave., Cincinnati 29, Ohio
Hydraulic Press Mfg. Div., Mount Gilead, Ohio.
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Oilgear Co., 1569 W. Pierce St., Milwaukee, Wis.
Vickers Inc., Administrative & Engineering Center, Box 302, Detroit 32, Mich.
Wood R. D., 1072 Public Ledger Bldg., Philadelphia 5, Penna.

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VISES, Machine
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Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling & Grinding Mches., Inc., 4701 Marburg Ave., Cincinnati 9, Ohio.
Cincinnati Milling Mch. Co., Oakley, Cincinnati 9, Ohio.
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Logansport Machine Co., Inc., 810 Center Ave., Logansport, Ind.
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Universal Engineering Co., Frankenmuth 2, Mich.
Wesson Co., 1220 Woodward Heights Blvd., Detroit 20, Mich.

WAY COVERS
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Lincoln Electric Co., 22801 St. Clair Ave., Cleveland, Ohio.
Linde Co., 30 E. 42nd St., New York 17, N. Y.

WELDING EQUIPMENT, Gas
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Linde Co., 30 E. 42nd St., New York 17, N. Y.

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Eisler Engrg. Co. Inc., 750 South 13th St., Newark, N. J.

WELDING POSITIONERS
Eisler Engrg. Co., Inc., 750 South 13th St. Newark, N. J.

WELDMENTS
Bliss, E. W. Co, Canton, Ohio.
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Allegheny Ludlum Steel Corp., Pittsburgh, Pa (Stainless)
Bethlehem Steel Co., Bethlehem, Pa.
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U. S. Steel Corp., 525 Wm. Penn Pl., Pittsburgh 30, Penna.
Vanadium-Alloys Steel Co., Latrobe, Penna.

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Eisler Engrg. Co., Inc., 750 South 13th St., Newark, N. J.
U. S. Tool Co., Inc., 255 North 18th St., Ampere, E. Orange, N. J

WOODWORKING MACHINES
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Greaves Mch. Tool Div., 2011 Eastern Ave., Cincinnati 2, Ohio.
Greenlee Bros. & Co., 2136—12th St., Rockford, Ill.

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Allen Mfg. Co., Bloomfield, Conn.
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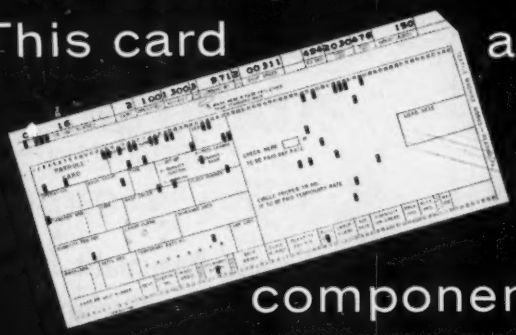

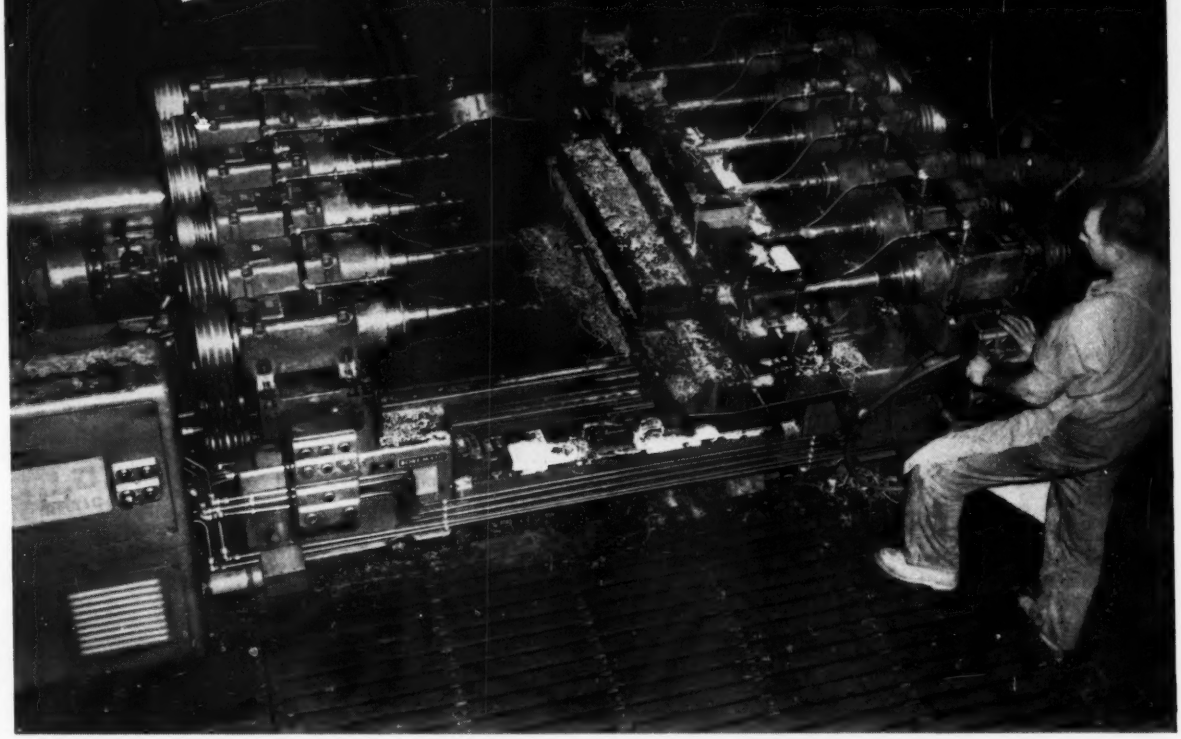

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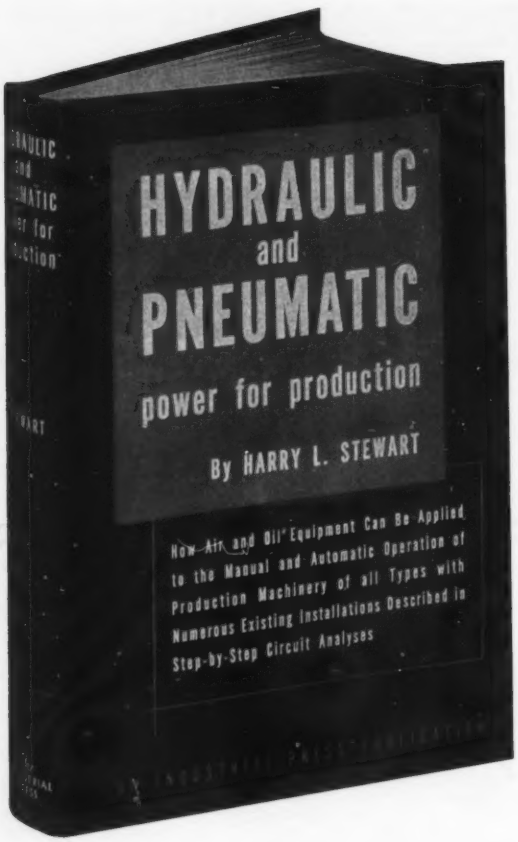
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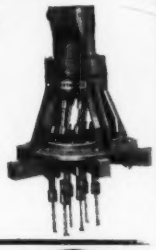

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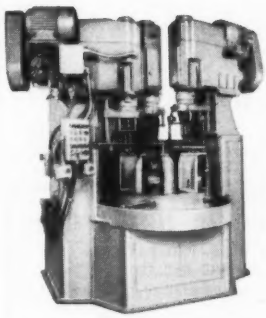

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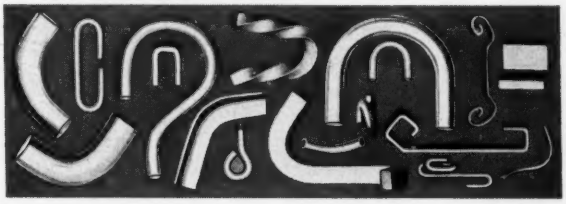

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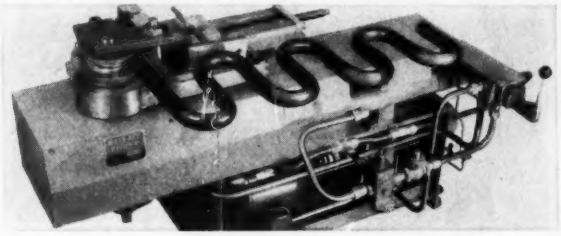

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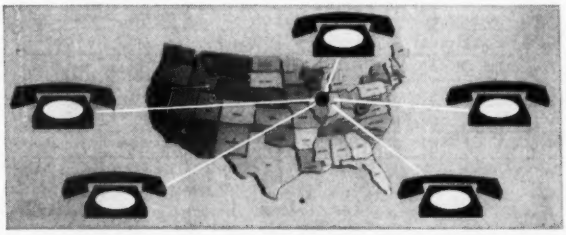

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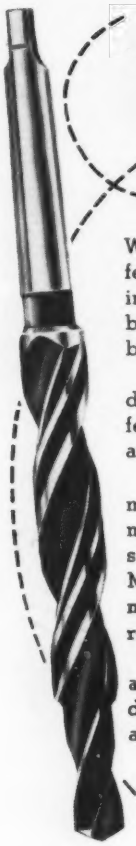

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Hole Location	Excellent	Good	Fair	Fair
Drill Hole Size	Excellent	Poor	Fair	Fair
Pieces Per Grind	Excellent	Fair	Excellent	Excellent
Burrs (None)	Excellent	Good	Fair	Zero
Tap Life	Excellent	Good	Fair	Poor
Regrind	Excellent	Poor	Excellent	Excellent
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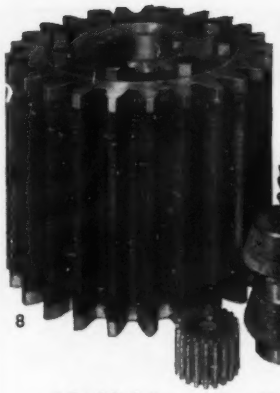

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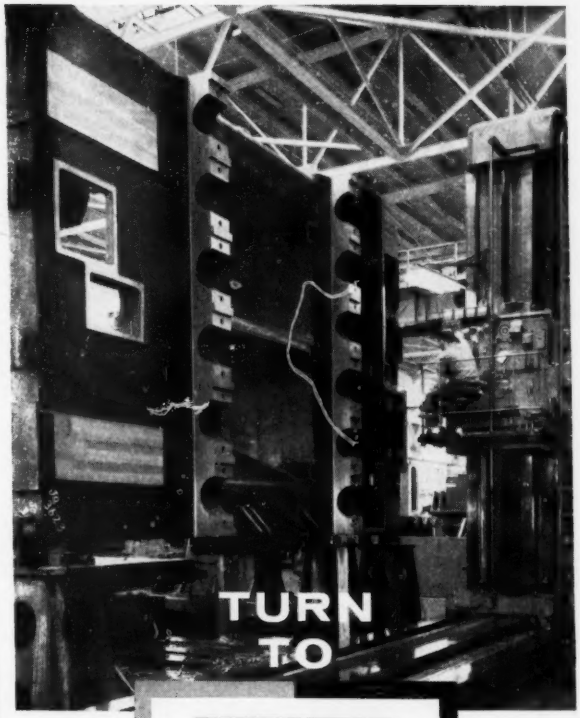

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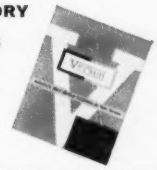

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Hole Drill, belted m.d.
Natco Horizontal Drill, 2 opposed B4F2 Head 1943
⅝" x 40" Bausch Double Horizontal Drilling Machine, m.d.
No. 445 W.F. & John Barnes Independent 2 spindle Deep Hole Drilling & Boring Machine, late
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No. 7 Fellows, 1945
No. 7, 7A Fellows Gear Shapers, belted m.d.
No. 18 Fellows Gear Finishing Machine, m.d.
No. 61A Fellows, m.d., latest type, 1945
No. 645A3 Fellows, vee belt drive
No. 645Y Fellows, m.d.
No. 70 Cross Deburring Machine, m.d., 1940
No. 72 Fellows H.S. Spur Gear Shaper, m.d.
No. 75 Fellows, H.S., m.d.
No. 75A Fellows H.S. Spur & Helical, m.d.
No. 712 Fellows, m.d.
No. 7125A Fellows, m.d., H.S.
No. 725 Fellows, 1945

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No. 36 Gould & Eberhardt Bevel & Spur Gear Rougher, m.d.
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No. 4-48" Brown & Sharpe, m.d.
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Type S Barber-Colman, m.d.
Type T Barber-Colman, m.d., 1942
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No. 12 Barber-Colman, double overarm, m.d.
No. 12 Barber-Colman, single overarm, m.d.
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No. 5D Gardner H.D. Polishing Stand, 1948

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Model 5Y Bryant, m.d.
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No. 16CR16 Bryant, m.d., latest
No. 16-22" Bryant, m.d., latest
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No. 16-A-28" Bryant, m.d.
No. 24—36" Bryant Hole & Face Type, m.d., late
No. 24-P-26" Bryant, m.d.
No. 24—21" Bryant, m.d.
No. 24—L—36" Bryant, m.d., late
No. 24-LW-36 Bryant, m.d., late
No. 649-16" Van Norman Automatic Oscillating Radius, m.d., latest
No. 70A Heald, m.d., latest, 1945
No. 72A3 Heald Full Universal, m.d.
No. 72A3 Heald Gagematic, m.d.
No. 72A3 Heald Plain Sizematic, m.d.
No. 72A3 Heald Plain, m.d.
No. 72A5 Heald Plain, m.d.
No. 73 Heald Airplane, m.d., latest, new
No. 74 Heald, Plain Long Base, m.d., 1943
No. 74 Heald, m.d.
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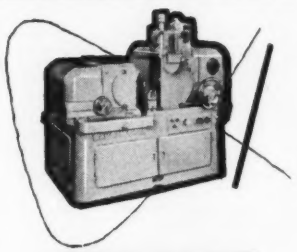

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Drill, Multiple: No. 48L Nateo, 36 spdl.
Drill, Upright: 21" Clm. Bick. 1L superservice late
Drill, Upright: 22" Barnes, late
Drill, Radial: 4'11" Carlton, 1941
Drill, Hydr.: No. 25 Ex-Cell-O, late
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Gear Shaver: 8" Red Ring, 1940
Grinder, C'less: No. 12 Landis, 1948
Grinder, C'less: No. 2 Cincinnati, Simatic
Grinder, Disc: 22" No. 221 Hanchett opposed
Grinder, Int.: No. 74 Heald, 1941
Grinder, Surf.: 12" x 36" Mattison, 1942
Grinder, T&C: No. 2 Cincinnati, 1944
Grinder, Univ.: 10x24 & 12x36 Landis, late
Lathe, Auto.: 8" x 15" Sundstrand
Lathe, Auto.: No. 8 Gisholt, 1950
Lathe: 16" x 54" American Pacemaker, 1941
Lathe, Engine: 24" x 120" Monarch Model CM, 1943
Lathe: 25" x 72" Axelson, 1944
Lathe,, turret: 9½" Hole No. 4L Gisholt
Mills, Boring: 60" Gisholt, vert. QCG
Mills, Prd.: No. 33 Sundstrand Fluid-Screw, 1942
Mills, Prd.: No. 5-48 Cincinnati, late
Mill: No. 3H K&T, plain, 1943
Mill: No. 5H K&T, plain, vert. hd., 1941
Mill: No. 3KM K&T vert., 1943
Mill: No. 36 VanNorman, ram, 1942
Mill: 42" x 42" x 18" Ingersoll planer type
Planer: 66" Rockford Hydr. open side, 1941
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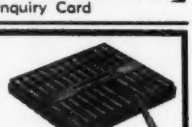

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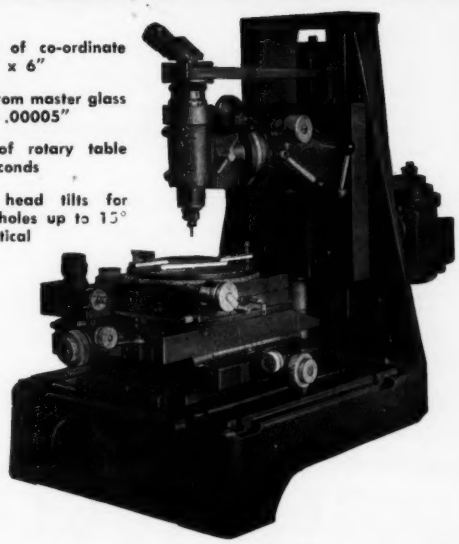

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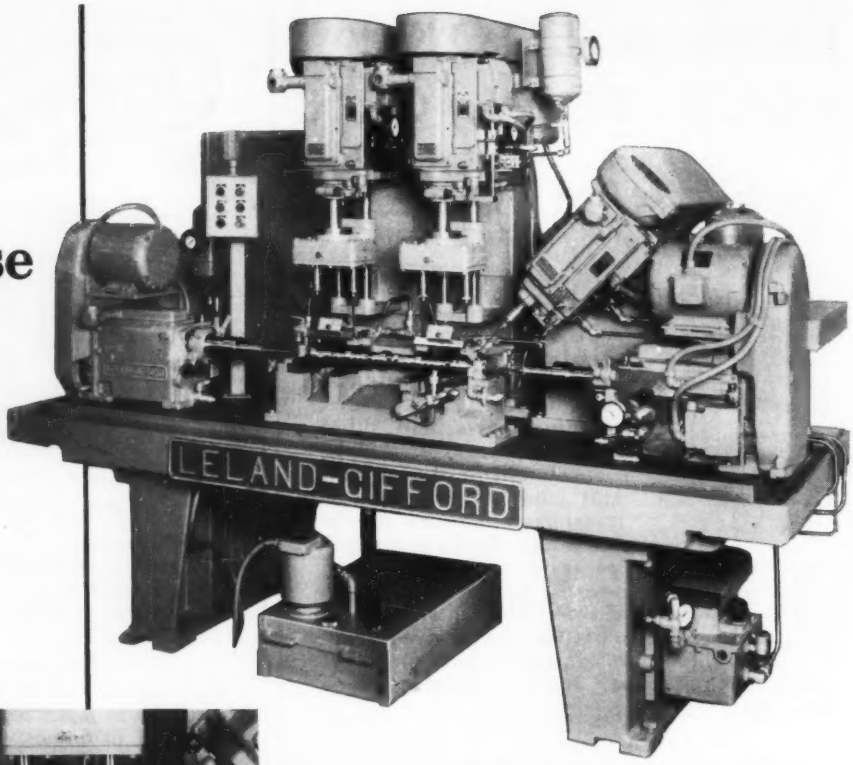

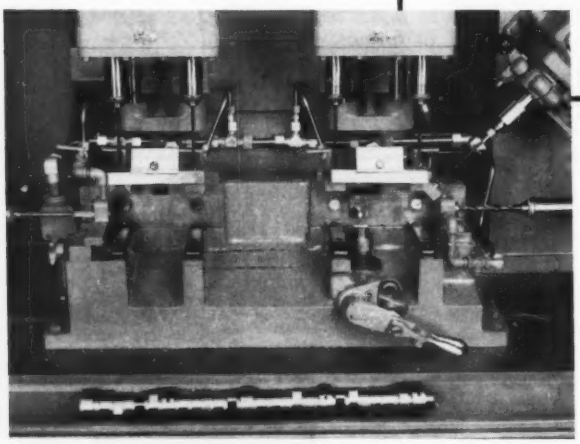

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Leland-Gifford has time-saving, cost-cutting ideas for you, too — ways you can combine multiple operations into a simple, efficient unit operation.

THE JOB: Drill one end of camshaft and ream the other while drilling four cross holes and one angular oil hole.

THE MACHINE: A Leland-Gifford special with five No. 2 self-contained units and standard hydraulically clamped fixture interlocked with drilling units to start feed after clamping and to unclamp when operation is finished. SC units are interlocked to prevent interference between cross and axial drills. One operator completes 60 camshafts per hour at 100% efficiency.

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Alphabetical Index of Advertisers

A

Air Reduction Sales Co. 28
Allegheny Ludlum Steel Corp. . 38
Allen-Bradley Co. 226
American Brass Co. 193
American Steel Foundries ... 179
American Tool Works Co. 75
Ames, B. C., Co. 20
Armstrong-Blum Mfg. Co. ... 263
Armstrong Bros. Tool Co. 30
Atlas Press Co., Clausing Div. 257

B

Barber-Colman Co. Insert 42-43, 48
Barnes Drill Co. ..... Insert 41
Baush Machine Tool Co. 53
Bethlehem Steel Co. 221
Birdsboro Steel Foundry & Machine Co. 259
Blanchard Machine Co. 213
Bliss, E. W., Co. 59
Bodine Corp. 235
Boston Gear Works 239
Bridgeport Machines, Inc. 165
Brook Motor Corp. 242
Buffalo Forge Co. 22-23
Buhr Machine Tool Co. Insert 67-70
Bullard Co. 253
Bunting Brass and Bronze Co. 228

C

Cadillac Gage Co. 66
Chicago Pneumatic Tool Co. 62-63
Cincinnati Bickford Div., Giddings & Lewis Mch. Tool Co. 204-205
Cincinnati Milling Machine Co., Meta-Dynamics Div. 195
Cincinnati Milling Machine Co., Milling Machine Div. 6-7
Cincinnati Shaper Co. 32
Cities Service Oil Co. 219
Classified Advts. 272
Clausing Div., Atlas Press Co. 257
Clearing Div., U. S. Indus. Inc. ..... Back Cover
Cleveland Crane & Engrg. Co. . 58
Cogsdill Twist Drill Co. Inside Back Cover
Columbus Die-Tool & Mch. Co. 254
Consolidated Machine Tool Div., Farrel-Birmingham Co., Inc. 56
Cross Company 16-17
Cuno Engineering Corp. 61

D

Davis & Thompson Co. 260
Deltronic 273
Detroit Power Screwdriver Co. 256
De Vlieg Mch. Co. 26-27
Diefendorf Gear Corp. 271
DoAll Co. 65
Dykem Co. 273

E

Eastman Kodak Co. 251
Eisler Engineering Co., Inc. .. 275
Elmes Engineering Div., American Steel Foundries . 179
Ex-Cell-O Corp. 25, 29, 185

F

Fafnir Bearing Co. 203
Farrel-Birmingham Co., Inc., Consolidated Machine Tool Div. 56
Fellows Gear Shaper Co. 4-5
Futurmill, Inc. 252

G

Gardner Machine Co. 21
Gear-O-Mation Div., Michigan Tool Co. 24
Geometric-Horton Divs., United Greenfield Corp. . Insert 211-212
Giddings & Lewis Mch. Tool Co., Cincinnati Bickford Div. 204-205
Gisholt Machine Co. .. Insert 33-36
Gleason Works 209
Goss & DeLeeuw Mch. Co. 222
Gray, G. A. Co. 18-19
Greaves Machine Tool Co. 218
Greenfield Tap & Die Div., United Greenfield Corp. Insert 211-212
Greenlee Bros. & Co. .... Insert 45

H

Hannifin Co., Div., Parker-Hannifin Corp. 169A-169B
Hardinge Brothers, Inc. ... 86, 170
Heald Machine Co., The Inside Front Cover
Horsburgh & Scott Co. 232
Hydraulic Press Mfg. Co. 71

I

Industrial Distributors (Sales), Ltd. 72-73
Industrial Press 246-247

J

Jessop Steel Co. 241
Johnson Manufacturing Corp. 261
Jones & Lamson Machine Co. 82, 249

K

Kaufman Manufacturing Co. . 269
Kearney & Trecker Corp. 223, 237

L

Landis Machine Co. 2-3
Landis Tool Co. 8-9
Leland-Gifford Co. 274
Lincoln Electric Co. 207
Lodge & Shipley Co. 64
Lucas Machine Div., New Britain Machine Co., The Insert 173-174

M

Macklin Co. 197
Madison-Kipp Corp. 248
Malleable Castings Council Insert 50, 51
Mattison Machine Works Insert 44
Michigan Tool Co., Gear-O Mation Div. 24
Micromatic Hone Corp. .. 244-245
Micro-Path, Inc. 198
Minster Machine Co. 31
Mitts & Merrill 258
Mohawk Tools, Inc. 270
Monarch Machine Tool Co. ... 177
Moore Special Tool Co., Inc. .. 60
Mueller Brass Co. 190-191
Mummert-Dixon Co. 270

N

National Acme Co. 54-55
National Broach & Machine Co. 169
New Britain Machine Co., The Lucas Machine Div. Insert 173-174

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For more data circle Item 715 on Inquiry Card

Alphabetical Index of Advertisers

New Britain Machine Co., The New Britain-Gridley Machine Div. .. 78, Insert 79-80, 81
New Jersey Gear & Mfg. Co. .. 275
Niagara Mch. & Tl. Wks. 77
Norton Company ..... Insert 37

O

Oliver Instrument Co. 57
Olofsson Corp. 181
Opto-Metric Tools, Inc. 273

P

Pangborn Corporation 276
Pannier Corp. 250
Parker Fittings & Hose Div., Parker-Hannifin Corp. 169A-169B
Parker-Hannifin Corp. 169A-169B
Parker Hydraulics Div., Parker-Hannifin Corp. 169A-169B
Parker Seal Co., Div., Parker-Hannifin Corp. 169A-169B

R

Rockford Machine Tool Co. Insert 40
Rowbottom Machine Co. 273
Ruthman Machinery Co. 236
Ryerson, Joseph T. & Son, Inc. 88

S

Safety Socket Screw Co. 220
Scherr, George, Co., Inc. 271
Schrader's A, Son, Div. Scovill Mfg. Co., Inc. 215
Sheffield Corp. 229
Sheldon Machine Co., Inc. 234
Shell Oil Co. 52
Shenango Furnace Co. 224
SKF Industries, Inc. 74
Skinner Electric Valve Div. Skinner Chuck Co. 84
Snyder Corp. 183
Stahl Gear & Machine Co. 270
Standard Oil Co. (Indiana) .. 83
Stromberg-Carlson Div., General Dynamics Corp. ... 243
Sundstrand Machine Tool Co. Insert 46-47

T

Texaco, Inc. 189
Textile Machine Works 267
Threadwell Tap & Die Co. 233
Thriftmaster Products Corp. . 269
Timken Roller Bearing Co. Steel & Tube Div. 231
Tomkins-Johnson Co. 217
Trabon Engineering Corp. ... 49
Ty-Sa-Man Machine Co., Inc. . 214

U

U.S. Tool Company, Inc. 10-11
Universal Engineering Co. ... 76

V

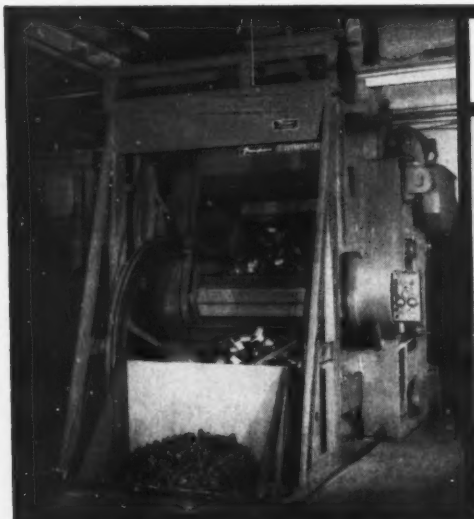
Van Norman Machine Co. .. 12-13
Vascoloy-Ramet Corp. 167
Verson Allsteel Press Co. 271
Vickers, Inc. 255

W

Waldes Kohinoor, Inc. 187
Walker, O. S. Co., Inc. 225
Wallace Supplies Mfg. Co. 269, 270
Warner & Swasey Co. 14-15

Y

Yoder Co. 238



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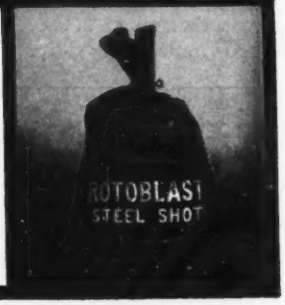

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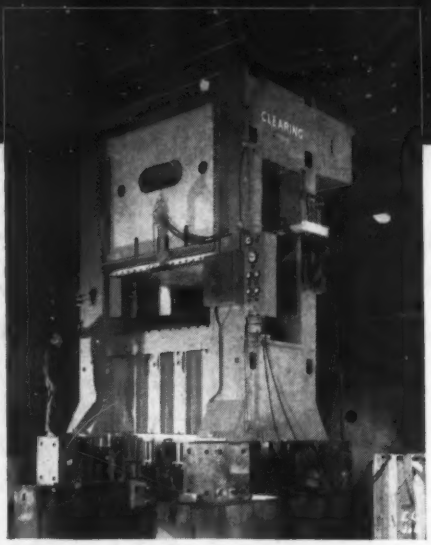

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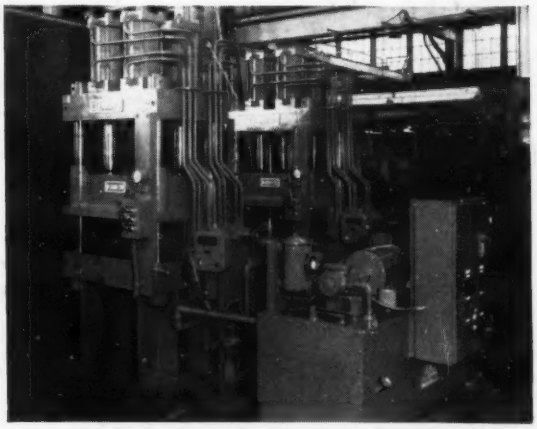
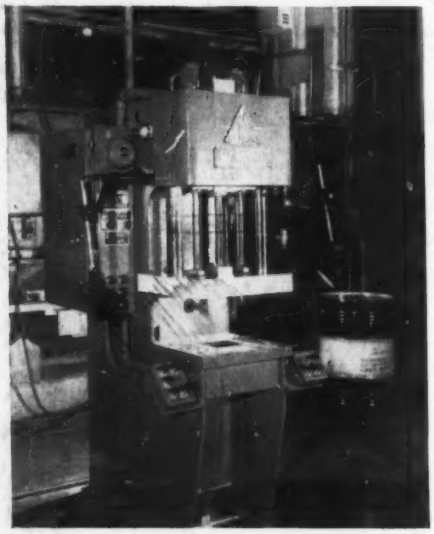


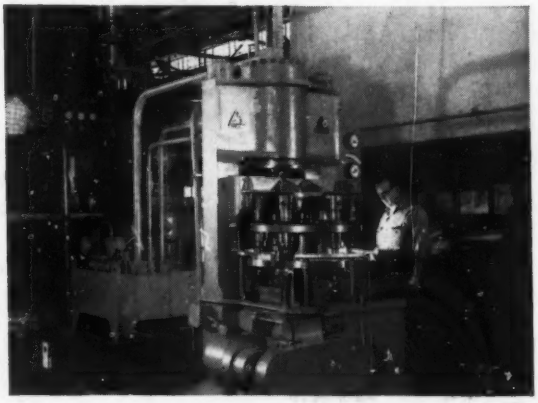
BOWLING BALLS—*MOLDING*

These two steam heated, 200 ton column-type hydraulic presses are designed for multiple cavity molding and operated from a single power source.



DIE CASTING—*TRIMMING*

High speed trimming is done on this 10 ton hydraulic gap press.



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